



April 12, 2024

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Shadow Mountain Bike Park - Case No. Case No. 23-102980 RZ

Dear Mr. Monke,

We are in receipt of the Second Referral Agency List, dated January 2, 2024. As part of the second referral of the application for a special use for the Shadow Mountain Bike Park project (the “**Application**”), we understand that the following agencies were provided with the opportunity to comment on the Application and provided comments:

- Cartography - khagaman@jeffco.us;
- CDOT Mountains - bradley.Sheehan@state.co.us; david.dixon@state.co.us;
- Colorado Parks and Wildlife NERO - Mountains - mark.lamb@state.co.us;
- Colorado State Forest Service - matt.piscopo@colostate.edu;
- CORE Electric Cooperative – bkaufman@core.coop
- Current Planning - NNELSON@jeffco.us¹
- Division of Water Resources - sarah.brucker@state.co.us; joanna.williams@state.co.us;
- Elk Creek Fire Protection - rparker@elkcreekfire.org; jware@elkcreekfire.org;
- Geologist - poconnel@jeffco.us;
- Historical Commission – tmaurer@jeffco.us; kbryson@jeffco.us
- Long Range - hgutherl@jeffco.us;
- Planning Engineering - NSEYMOUR@jeffco.us
- Public Health - publichealthelanduse@jeffco.us;
- Summit Utilities – jgutierrez@summitutilitiesinc.com
- Transportation and Engineering - ltownsen@co.jefferson.co.us; mvanatta@co.jefferson.co.us;
- United Power Inc - platreferral@unitedpower.com;
- XCEL Energy - donna.L.George@xcelenergy.com;

The following agencies were provided with the opportunity to comment on the Application but did not provide comments:

- CDPHE (Colo Health) - cdphe_localreferral@state.co.us;
- Army Corps of Engineers - kiel.g.downing@usace.army.mil;
- CSU Extension -
- Colorado Historical Society – oahp@state.co.us
- Colorado Natural Gas - jgutierrez@summitutilitiesinc.com;

¹ We understand this item to refer to the Planning and Zoning comments.

April 12, 2024

Page 2

- Colorado State Land Board - greg.ochis@state.co.us;
- Comcast - Alfonzo_Martinez@cable.comcast.com;
- LUMEN - platreview@lumen.com;
- Open Space - estoner@co.jefferson.co.us;
- Road & Bridge 4 - kdean@jeffco.us;
- US Fish and Wildlife Refuge Planning -
- Urban Agriculture Regional Education Coordination -

As a result of the comments received and follow-up discussions with referral agencies, the following items have been prepared or updated since the First Referral Response submittal, and are included in this resubmittal package:

1. Second Referral Response – Summary of Referral Comments – SMBP (this document)
2. Second Referral Response – Planning & Zoning – SMBP
3. Written Restrictions/ODP
 - a. Updated Item 2: Official Development/Special Use/Site Approval Plan [satisfies Zoning Resolution Section 9.B., Item 10] as described in the initial Application submittal
4. Engineering Study for Water System Improvements
 - a. Updated Item 12: Water [satisfies Zoning Resolution Section 9.B., Item 21] as described in the initial Application submittal
5. Engineering Study for Wastewater System Improvements
 - a. Updated Item 13: Wastewater [satisfies Zoning Resolution Section 9.B., Item 22] as described in initial Application Submittal
6. Wildfire Hazard Mitigation Plan
 - a. Updated Item 14: Fire Protection [satisfies Zoning Resolution Section 9.B., Item 23] as described in the initial Application submittal
7. Second Referral Response – Transportation and Engineering – SMBP
 - a. Includes updated Item 15: Transportation Analysis [satisfies Zoning Resolution Section 9.B., Item 27] as described in the initial Application submittal
8. Phase I Drainage Report
 - a. Updated Item 19: Phase I Drainage Report [satisfies Zoning Resolution Section 9.B., Item 29] as described in the initial Application submittal
9. Sensory Impact Assessment
 - a. Updated Item 28: Sensory Impact Report/Plan [satisfies Zoning Resolution Section 9.B., Item 33] as described in the initial Application submittal
10. Second Referral Response – CPW – SMBP
 - a. Includes updated Item 29a: Wildlife Summary [Satisfies LDR Section 4.B., Item 31] as described in the initial Application submittal
11. Second Referral Response – Historical Commission – SMBP
 - a. Includes Item 30: Historical, Archaeological, and Paleontological Report/Plan [Satisfies Land Development Regulation Section 4.B., Item 36] as described in the initial Application submittal
12. Second Referral Response – Public Health – SMBP

April 12, 2024
Page 3

13. Second Referral Response – Long Range Planning - SMBP

We look forward to your continued cooperation in connection with the Application. Please do not hesitate to reach out should you have any questions or require additional information.

Sincerely,



Phil Bouchard
Shadow Mountain Bike Park



Jason Evans
Shadow Mountain Bike Park



April 12, 2024

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Shadow Mountain Bike Park - Case No. Case No. 23-102980 RZ

Dear Mr. Monke,

We are in receipt of the Second Referral Response Letter from Jefferson County Planning and Zoning, dated January 30, 2024, as part of the second referral of the application for a special use for the Shadow Mountain Bike Park project (the "Application"). With this letter, we are providing the following responses to comments received.

I. General

Comment 1. *The submitted Official Development Plan (ODP) has some proposed uses that are redundant with the existing Agricultural Two (A-2) entitlements. Please review the ODP document and remove these occurrences where adjustments are not proposed. Staff is unclear the volume, size, and location of several items including: food vendors, retail area(s) and signage. Please see the attached ODP for complete redmarks. The applicant will be required to provide a number of additional details to refine compatibility, visual impacts, proposed use, noise, wildfire hazards, and site design.*

Response: Comments have been addressed and are included in the ODP and Written Restrictions provided with this submittal package.

Comment 2. *The First Referral found that the applicant's proposal would not meet with the Conifer/285 Corridor Area Plan recommended land use for this site. The Comprehensive Master Plan recommends this area for 1 dwelling unit per 10 acres. The applicant provided justification instead for the following three factors when assessing proposed uses that are not supported by the Plan:*

- a) how will the impacts associated with the proposed land use(s) be mitigated compared with the recommended Land Uses;*
- b) are the proposed land uses compatible with the surrounding Land Use Recommendations and community character; and*
- c) what change of circumstance has occurred in the local area since the Land Use Recommendation was adopted.*

Applicant responses were provided in detail, see Long Range Response for specific evaluations. A separate meeting on these items is encouraged if clarification is desired.

Response: We have discussed these matters with Long Range Planning and have addressed edits accordingly. See “Second Referral Response – Long Range Planning – SMBP” where these criteria are addressed in detail.

II. ODP Document

***Comment 1.** Setbacks - 50-foot are proposed for the Day Lodge and Accessory Building. These match the existing entitlements for other commercial permitted uses such as a Veterinary hospital or and Greenhouse/nursery. However, the proposed parking does not have any setbacks from property lines proposed in the ODP document. Staff would like to see these pushed back from property lines or otherwise screened from view with language to require hardscaping, screened behind primary building(s), landscaping requirement or other means to mitigate visual impact and compatibility with surrounding lots.*

Response: We have added clarifying setback language for parking in the updated ODP and Written Restrictions document. Additionally, in our Visual Analysis submitted with our First Referral Response package, we commit to planting vegetation along the edge of the parking lot to strategically screen the base area facility, lift terminal, and bike park activity from Shadow Mountain Drive. Additionally, our Vegetation Preservation Plan places priority on preserving and protecting existing vegetation along Shadow Mountain Drive frontage and within wetland and riparian areas, which would support screening of the parking lot area. The ODP document included in this resubmittal package has been updated to incorporate the Vegetation Preservation Plan recommendations as well, for clarity.

***Comment 2.** Parking Standards - The ODP proposes a maximum number of spaces, but no setbacks or minimum # of spaces. Most often these are proposed at a ratio of Gross Leasable Area (GLA) e.g. 1 parking space per 1,000 GLA required. Staff would prefer phrasing of a ratio proposed to match this style of enforceable language and a setback from the property line as described above.*

Response: As mentioned above, we have added parking setback language to the ODP document included in this resubmittal package. We also added a parking minimum of 1.0 space per 6 guests based on the County parking minimums table for a Recreation Center, Health Club (1.0 per 6 occupancy rating).

***Comment 3.** Sound - Staff encourage adding a note that outdoor amplification be prohibited except by Special Event Permit occurrences. Outdoor amplification is not a compatible use with surrounding residential and agricultural use(s).*

Response: We understand that outdoor amplification is not a compatible use with surrounding residential and agricultural uses. Additionally, we understand that the Jefferson County Open Space Recreation and Activity Management Guide for 2024-2025 prohibits amplified music, concerts, and other amplified noise in all parks. We are willing to restrict outdoor amplification at the bike park except for announcements and Special Event Permit occurrences and have included this language in the ODP.

Comment 4. Site Mitigation - The Wildfire Risk Assessment has removed the 300-foot buffer area without explanation. More information should be provided as to why this recommendation was removed between referrals. The Assessment also calls for mitigation of Shadow Mountain Drive for a portion significantly off-site to the east. It is unclear how this will be met without County approval or adjacent property owner easement(s). See Management Area H, subset 2 for the eastern section. It is also unclear how overall property treatment will be managed between identified management areas, please provide more information.

Response: We considered the implementation of a 300-foot setback for wildfire risk. This setback was recommended in order to create a safety zone on the Property in event of a wildfire. As indicated in the Wildfire Hazard Mitigation Plan included with the first referral resubmittal package (and updated in this second referral resubmittal package), mitigation along Shadow Mountain Drive is recommended instead to provide a safe evacuation corridor in event of a wildfire. In other words, the plan in the event of a wildfire has changed from creating a safety zone on the property to shelter in place to opting for evacuation. This was due to a number of factors, including the feasibility of creating the safety zone on the property (and the scenic/environmental impacts that would have come with it), the other mitigation measures proposed through the Wildfire Hazard Mitigation Plan, and discussions with both the Elk Creek Fire Protection District (correspondence 8/25/2023) and Road & Bridge (correspondence 9/14/2023) which indicated that both agencies were willing to consider this approach. This recommendation would also provide benefits to other residents in the vicinity who would travel along Shadow Mountain Drive in case of an evacuation event.

Regarding Management Area H and mitigation along Shadow Mountain Drive, we cannot commit to mitigation techniques offsite but have discussed this recommendation with our Case Manager and with Jefferson County's Road & Bridge department, and they are willing to work with us to consider mitigation within the ROW. We also believe that mitigation along Shadow Mountain Drive is in the best interests of adjacent private property owners due to its benefits to forest health and the safety of the entire Shadow Mountain community in the event of a fire, and therefore are optimistic that adjacent landowners will be willing to collaborate with us particularly because we plan to oversee implementation of the mitigation efforts including through financial contributions.

Lastly, the Wildfire Hazard Mitigation Plan has been updated to describe the recommended property treatments between management areas; please see the updated Plan included in this resubmittal package.

Comment 5. Seasonal Closure - Colorado Parks and Wildlife call for "limit disturbance" during period of January – July 1. Its unclear what extent "limit" is intended by this language. The applicant is strongly encouraged to coordinate with CPW to understand these comments.

Response: We have followed up with Colorado Parks and Wildlife on their recommendations and have prepared a response letter included with this resubmittal package. See "Second Referral Response – CPW – SMBP" where this comment is addressed in detail.

Comment 6. *Landscaping - The property is not expected to meet wildfire mitigation and the County Landscape standards outside of the Parking Lot Area. See redmarks for suggested language.*

Response: Noted; this language has been updated in the ODP document included in this resubmittal package.

Comment 7. *Please review the attached ODP document with red marks related to formatting and content.*

Response: Noted.

III. Plan Recommendation

Comment 1. *The Comprehensive Master Plan recommends this area for 1 dwelling unit per 10 acres.*

Response: Noted.

IV. Wildfire Hazard Mitigation Plan

Comment 1. *Please describe the overall site treatments recommended between identified Unit Management Areas.*

Response: Please see the updated Wildfire Hazard Mitigation Plan included in this resubmittal package for a description of the overall site treatments between management areas.

V. Traffic & Engineering

Comment 1. *Shadow Mountain Drive has been identified to be upgraded to a Major Collector Classification based on current traffic counts. Westbound left turn land will be required at site access. While physical improvement would not be required at time of Special Use review, the applicant should be aware that proposed setbacks will be taken from edge of roadway alignment after this treatment is completed.*

Response: The Traffic Assessment has been updated to incorporate this comment and additional correspondence with our case manager and the County Planning Engineer.

Comment 2. *Phase I Drainage Report comments remain unaddressed, see redmarks.*

Response: Please see the updated Phase I Drainage Report included in this resubmittal package.

Comment 3. *Traffic analysis states 1,000 vehicle trip maximums whereas ODP notes 1,200. More information is needed on supporting these assumptions.*

April 12, 2024
Page 5

Response: Please see the updated Traffic Assessment included in this resubmittal package, where this is described in more detail.

VI. Documents required for second submittal.

1. Revised ODP and Written Restrictions – *See ODP Written Restrictions*
2. Revised Transportation Information – *See Transportation*
3. Revise Wildfire Mitigation Plan – *See Wildfire Hazard Mitigation Plan*

Sincerely,



Phil Bouchard
Shadow Mountain Bike Park



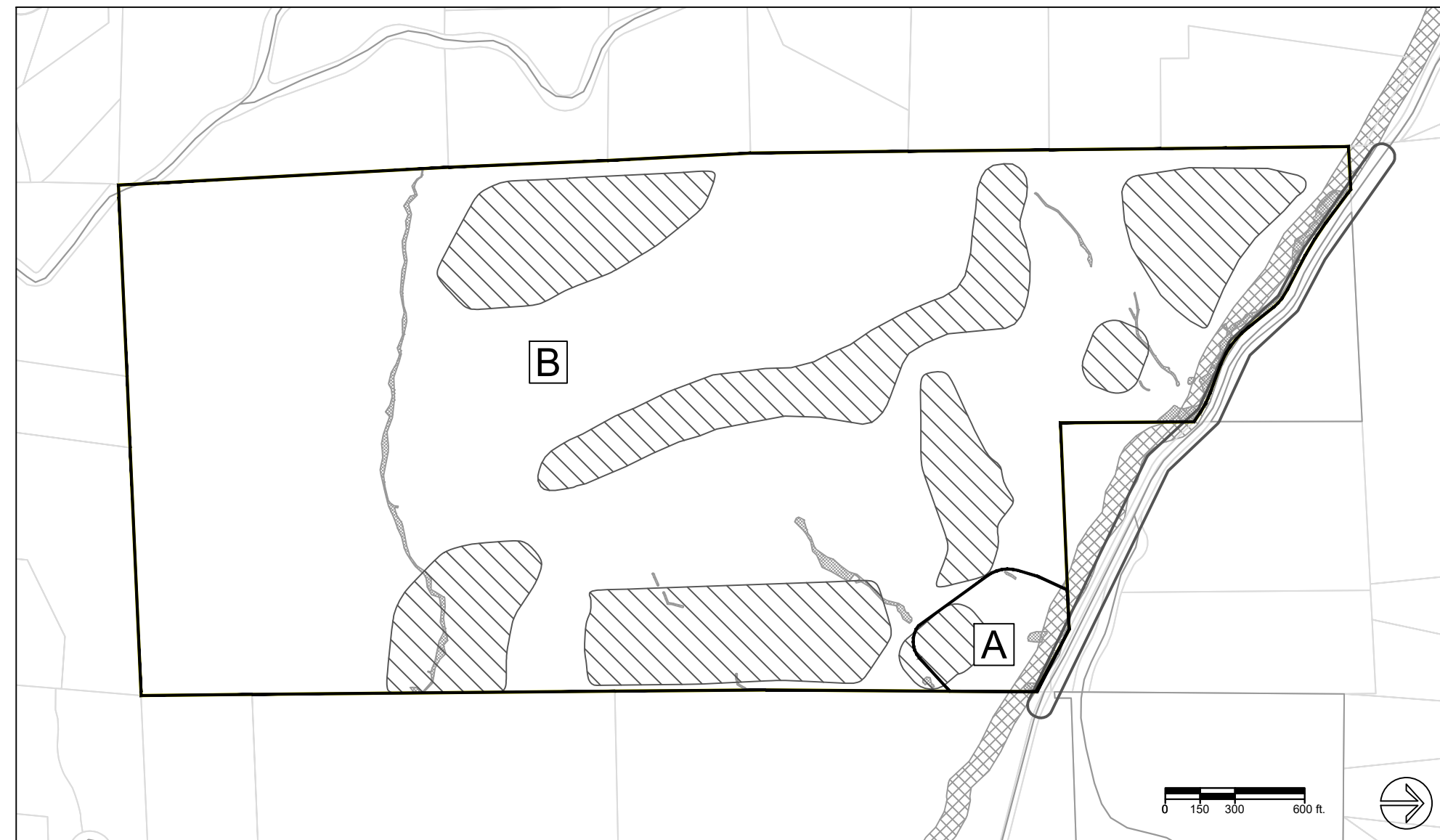
Jason Evans
Shadow Mountain Bike Park

Shadow Mountain Bike Park OFFICIAL DEVELOPMENT PLAN

CASE NUMBER: 23-102980 RZ

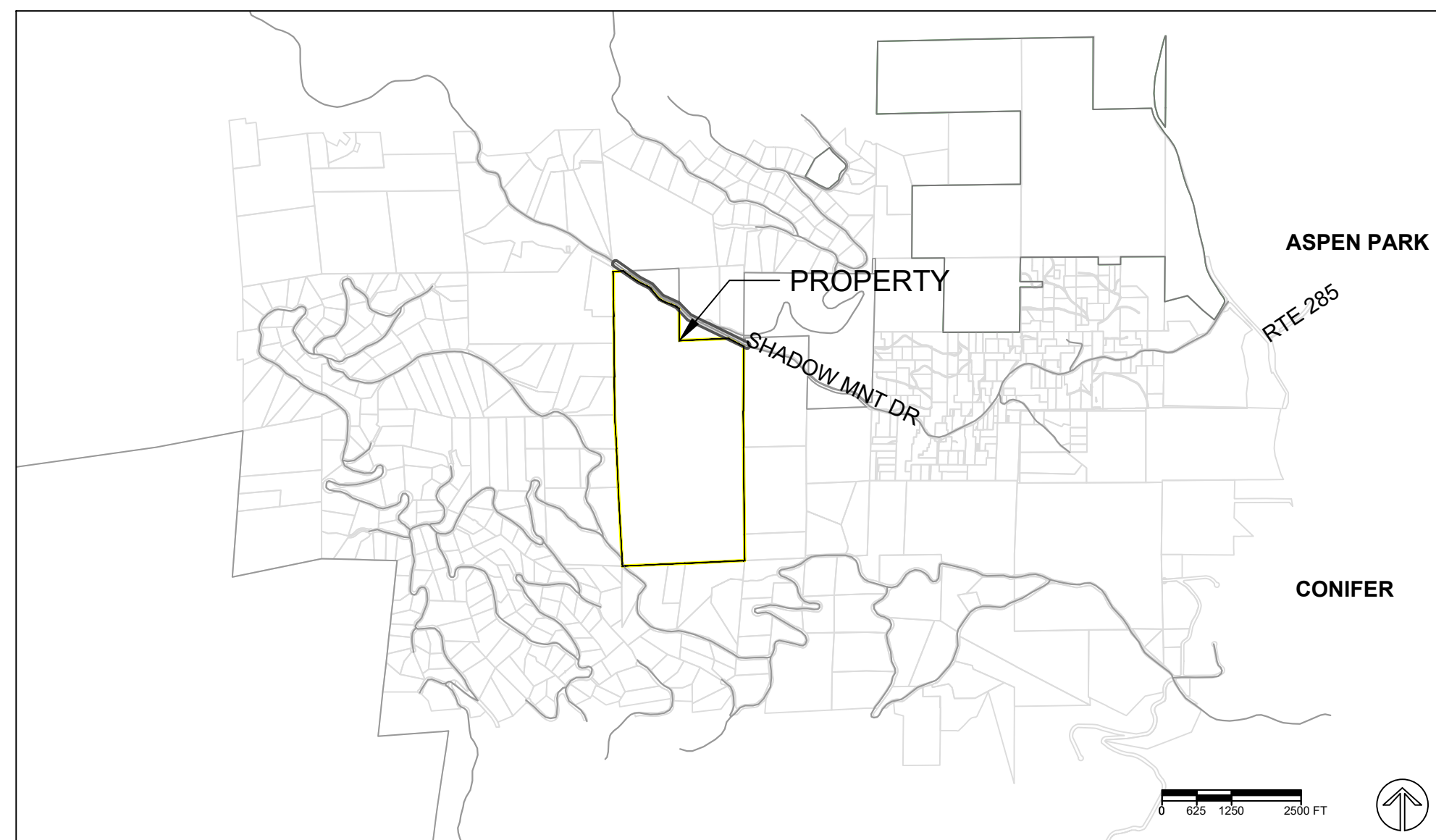
S2NW, SW, AND A FRACTIONAL PART OF THE NWNW (S OF SHADOW MOUNTAIN DRIVE)
IN SECTION 16, TOWNSHIP 6 SOUTH, RANGE 71 WEST, OF THE 6TH PRINCIPAL MERIDIAN
COUNTY OF JEFFERSON, STATE OF COLORADO

PAGE 1 OF 2



USE AREAS
SCALE 1"=600'

- WILDFIRE HAZARD MITIGATION PLAN TREATMENT AREAS
- WETLANDS
- JEFFERSON COUNTY FLOOD PRONE AREA



VICINITY MAP
SCALE 1"=2500'

LEGAL DESCRIPTION

Parcel ID 61-163-00-001 is more particularly described by the metes and bounds of the said 306 acres, it is owned by the Colorado State Land Board. The corner quarter coordinates S 43° 07'29" E and N 00°19'28" W and is a locally preserved 70 acre quarter corner of the used 235 acre parcel #61-00-001. This 70 acre parcel corner sits S of Shadow Mtn Drive Road with road frontage facing the southeast quarter of Shadow Mountain Drive Road containing a R.O.W. of 60'. This quarter corner commences at the S2NW, SE and quarter corner of the NWNW said section 16, Township 6 South Range 71 West of 6th principal Meridian.

APPROVED FOR RECORDING:

This Special Use Document, titled Shadow Mountain Bike Park, was approved the _____ day of _____ 2024, by the Board of County Commissioners, of the County of Jefferson, State of Colorado and is approved for recording.

The owner of the property, at the time of approval was: State of Colorado

By: Jefferson County Planning and Zoning Director

Signature: _____

Date: _____

CLERK AND RECORDER'S CERTIFICATE

Accepted for filing in the Office of the County Clerk and Recorder of Jefferson County at Golden, Colorado, this _____ day of _____, 20 _____.

County Clerk and Recorder

Deputy Clerk

STANDARD FLEXIBILITY STATEMENT

The graphic drawing contained within this Official Development Plan is intended to depict general locations and illustrate concepts of the textual provisions of this Official Development Plan. During the plotting or Site Development Plan process the Planning and Zoning director may allow minor variations for the purpose of establishing:

- A. Final road alignments
- B. Final configuration of lot and tract sizes and shapes
- C. Final building envelopes
- D. Final access and parking locations
- E. Landscaping adjustments

APPLICABILITY STATEMENT

Except as expressly provided otherwise in this Official Development Plan, development of this property shall conform to the Jefferson County Zoning Resolution in effect at the time of platting, Site Development Plan, and building permit application.

OWNER'S CERTIFICATE

We, Colorado State Land Board, as owners of the land affected by this Planned Development, accept and approve all conditions set forth.

Abraham Medina
Recreation Program Manager
State Land Board

Accepted for filing in the Office of the County Clerk and Recorder of Jefferson County at Golden, Colorado, this _____ day of _____, 20 _____.
County Clerk and Recorder _____
Deputy Clerk _____

DATE	ISSUED FOR	REVISION #

PREPARED BY:

SE GROUP, INC.
PO BOX 2729
FRISCO, CO 80443
www.segroup.com

Shadow Mountain Bike Park OFFICIAL DEVELOPMENT PLAN

CASE NUMBER: 23-102980 RZ

S2NW, SW, AND A FRACTIONAL PART OF THE NWNW (S OF SHADOW MOUNTAIN DRIVE)
IN SECTION 16, TOWNSHIP 6 SOUTH, RANGE 71 WEST, OF THE 6TH PRINCIPAL MERIDIAN
COUNTY OF JEFFERSON, STATE OF COLORADO

PAGE 2 OF 2

WRITTEN RESTRICTIONS

- A. **Intent.** The purpose of this Special Use is to permit a Class III Commercial Recreation Facility use for lift-assisted mountain biking and associated uses.
- B. **Written Restrictions.** All standards of the Agricultural Two Zone District (A-2) and other applicable sections of the Zoning Resolution shall apply to the Property, with the modifications contained herein. Capitalized terms not defined herein shall have the meanings ascribed to them in the Jefferson County Zoning Resolution.
 - 1. **Permitted Uses.**
 - a. **Primary Uses.**
 - i. Class III Commercial Recreation Facility, excepting therefrom any activity that involves the use of non-domestic animals and/or firearms
 - b. **Accessory Uses.**
 - i. Food and beverage vendors
 - ii. Maintenance Facilities
 - 2. **Development Standards**
 - a. **Use Area A.** (6 acres)
 - i. Building Standards
 - 1. Max Building Square Footage: 15,000 feet
 - 2. Setbacks: 50 feet from all Property lines
 - ii. Access Road(s) Setback: 50 feet from all Property lines
 - iii. Parking Setback: 50 feet from all Property lines
 - b. **Use Area B.** (229.3 acres)
 - i. Only permitted for accessory maintenance facilities
 - ii. Building Standards
 - 1. Max Building Square Footage: 5,000 square feet
 - 2. Setbacks: 50 feet from all Property lines
 - iii. Trail Standards
 - 1. Setbacks: 50 feet from all Property lines
 - 2. Trail clearing width: 30 feet maximum
 - iv. Chairlift Standards
 - 1. Max Chairlift Height: All Chairlift infrastructure (including terminals and towers) and accessory structures will not exceed 35 feet in height
 - 2. Setbacks: 150 feet from all Property lines
 - 3. Chairlift corridor clearing width: 40 to 60 feet in accordance with safety or chairlift commission regulations
 - 4. Chairlift terminals clearing: 200 feet maximum surrounding terminals
 - v. Access Road(s) Setback: 50 feet from all Property lines
 - 3. **Overlay Areas.**
 - a. **Wildfire Hazard Mitigation Overlay.** Mitigation strategies as outlined in the Wildfire Hazard Mitigation Plan will be implemented as part of Defensible Space Permit requirements

- b. **Wetlands Overlay.**
 - i. No permanent building, parking area, nor Chairlift is permitted in the Wetlands Overlay
 - ii. In the event that Access Road(s) cross the Wetlands Overlay, impacts will be minimized to the greatest extent possible
 - iii. In the event that Trail(s) cross the Wetlands Overlay, impacts would be avoided by bridging, raised platforms, or similar design
- c. **Jefferson County Flood Prone Area Overlay**
 - i. No permanent building, parking area, nor Chairlift is permitted in the Flood Prone Area Overlay
- 4. **Lighting.**
 - a. No exterior lighting is permitted in the Wetlands Overlay or Use Area B, except for lighting required in connection with the Chairlift
 - b. Lighting in Use Area A is permitted to be illuminated from one hour before to one hour after Guest Hours of Operation, except for security lighting, the use of which is not limited to certain hours
 - c. Lighting will be directed away from the Wetlands and Flood Prone Overlays
 - d. Building wall-mounted floodlights and rotating spotlights are prohibited
 - e. Light fixtures attached to any buildings shall not project above the fascia or roofline of such building, and shall not exceed 20 feet above the top of the building foundation
- 5. **Signage.**
 - a. No more than one permanent sign is permitted per building
 - b. Signs will be no closer than 50 feet from all Property lines, except for Entry Feature Sign(s) which are permitted on the Property
 - c. Signs will not be illuminated in any way
- 6. **Sound.**
 - a. Sound levels shall adhere to maximum permissible noise levels for residential uses
 - b. Outdoor amplification is prohibited except for announcements and Special Event Permit occurrences
- 7. **Fencing.**
 - a. Only wildlife friendly fencing is permitted on the Property as defined by CPW-recommended standards in the "Fencing With Wildlife in Mind" document
 - b. In Use Area A, standalone or small stands of aspen trees will be fenced to prevent browsing from animals
- 8. **Fires.**
 - a. Outdoor fires using wood or charcoal for fuel are prohibited
 - b. All outdoor fires of any type are prohibited in Use Area B
- 9. **Trash Management.**
 - a. Only wildlife-proof trash, recycling and composting containers are permitted to be used on the Property
 - b. Outside composting is prohibited
- 10. **Landscaping.**
 - a. Landscaping plans will integrate Wildfire Hazard Mitigation Plan and Vegetation Preservation Plan recommendations
 - b. The County landscaping regulations shall not apply except those standards for Parking Lot Areas as defined in Section 15 of the Jefferson County Zoning Resolution

- 11. **Parking.**
 - a. The maximum number of parking spaces will not exceed 320 spaces
 - b. The minimum number of parking spaces shall adhere to a ratio of 1.0 space per 6 occupancy rating
- 12. **Wildlife**
 - a. Bird feeders are prohibited on the property between April 1st and the Thanksgiving holiday
 - b. Only round door knobs are permitted on all exterior doors on the property
 - c. All crawl spaces and areas under ground level decks shall be fully enclosed to prevent wildlife access
- 13. **Operations.**
 - a. **Guest Hours of Operation.** The Shadow Mountain Bike Park will be open to guests no earlier than sunrise and no later than sunset
 - b. **Seasonal Closure.** The Shadow Mountain Bike Park will be closed to guests from January 1 through April 1 (the "Seasonal Closure")
 - c. **Motorized Use.**
 - i. Motorized use is prohibited on trails
 - ii. E-bikes are permitted on trails
 - d. **Guest Count.** The maximum number of guests visiting Shadow Mountain Bike Park in one day will not exceed 1,200 guests
- 14. **Definitions**
 - a. **Chairlift:** All infrastructure required for the operation, maintenance, and support of the lift structure, including but not limited to terminals, towers, lines, poles, chairs, electrical equipment, and other related components.
 - b. **Maintenance Facilities:** Operational, maintenance, and administrative services and facilities associated with the Class III Commercial Recreation Facility use.
 - c. **Trails:** Trails constructed for use by cyclists and, in some cases, individuals on foot or other non-motorized means of transportation.
 - d. **Food and Beverage Vendors:** Temporary food trucks outside of the Day Lodge or grab and go vendors within the Day Lodge, limited to vendors that do not require full kitchen space.
 - e. **Training Area:** An outdoor area for the purpose of training bike skills, which may include: structures, jumps, ramps, and obstacles, paths made of dirt, gravel, or other natural materials, and other mechanisms for the purpose of learning or practicing bike skills.
 - f. **Seasonal Closure:** An annual closure of Shadow Mountain Bike Park between January 1 and April 1 that does not permit guest access but does allow staff access and maintenance activities such as: construction of trails and infrastructure on an annual basis during development, trail maintenance, drainage maintenance, vehicle maintenance, facilities maintenance, or safety improvements.

DATE	ISSUED FOR	REVISION #

PREPARED BY:

SE GROUP, INC.
PO BOX 2729
FRISCO, CO 80443
www.segroup.com



April 12, 2024

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Shadow Mountain Bike Park - Case No. Case No. 23-102980 RZ

Dear Mr. Monke,

We are in receipt of the Second Referral Response Letter and email from Jefferson County Public Health (“JCPH”), dated January 8, 2024, as part of the second referral of the application for a special use for the Shadow Mountain Bike Park project (the “Application”).

In an email from JCPH, the following comments were included:

Comment 1. Last year, the applicant proposed that there would be a maximum of 320 guests at the park with a discharge of 1120 gpd. This has been changed to 1,200 guests per day and they also propose some type of food service in the day lodge.

Response: In our resubmittal package following the first referral, we established a maximum guest use of 1,200 guests per day. The original engineer reports for water and wastewater were based on average estimates of 300 guests and 20 employees; these reports have been updated to reflect maximum uses with 1,200 guests and up to 30 employees and are included in this second referral resubmittal package.

We have defined “Food and Beverage Vendors” in our Special Use Document/ODP included in this resubmittal package to provide more clarification around the food service we plan to offer, which would be limited to vendors that do not require kitchen space; this includes grab and go food service in the Day Lodge and independently operated food trucks outside of the Day Lodge. Because these offerings would not require kitchen space, they would not contribute to water or wastewater usage on the Property.

Comment 2. As such, with the 20 employees this will produce at a minimum 6,300 gallons per day. As such, they will need Site Approval from CDPHE for the OWTS and they will need to include what type of food service is provided to the public as that may also need to be included in daily wastewater flows. As such, they have not met the public health requirements with these amended changes.

Response: We have updated our engineer report on wastewater, which is included in our resubmittal package. The report is based on estimated maximum daily usage on the Property, with up to 1,200 guests and 30 employees.

As described above, food service would be limited to vendors that do not require kitchen space and therefore would not contribute to water or wastewater usage numbers.

Lastly, we have contacted our case manager on when we need to gain Site Approval from the CDPHE and haven't yet received guidance on this note. We assume that Site Approval from CDPHE is appropriate while we prepare a Site Development Plan, which would be our next step if this application were to be approved.

Comment 3. *At the time of building permit, they may need to submit plans regarding the food service they propose as it may require a plan review and routine inspections by this Department.*

Response: Comment noted; as mentioned above, food service would be limited to grab and go service (without kitchen space) and food truck offerings, neither of which would contribute to additional water and wastewater usage on the property. If this application is to be approved, a plan review and plans for routine inspections will be identified in the Site Development Phase.

Additionally, JCPH attached a letter response with the following items to be addressed:

I. Water

Comment 1. *The Jefferson County Zoning Resolution (Section 9 C.21) and the Land Development Regulation (LDR) Section 21.B.2.a (1) requires proof of legal water, such documentation may include, but is not limited to, a copy of the well permit or water court decree. The Colorado Division of Water Resources (CDWR) is the governing authority for wells. As such, the applicant should contact the Colorado Division of Water Resources at 303.866.3581 who will determine if the applicant has a legal right to the water supply.*

Response: Comment noted. Prior to Site Development Plan approval, we understand that we will need to provide proof of legal water supply.

Comment 2. *Please note that the well(s) will serve as a drinking water supply that serves a population of at least 25 people per day for at least 60 days per year and is not a non-transient, non-community water system or a community water system. As such, the water supply would meet the definition of a transient, non-community water system as defined in the Colorado Primary Drinking Water Regulations.*

Response: Comment noted.

Comment 3. ***The applicant must contact the Water Quality Control Division, Colorado Department of Public Health and Environment (CDPHE) at 303.692.3500 for a PWSID number and or permit as required as this well water supply will be regulated by the CDPHE, Water Quality Control Division.***

Response: Comment noted. We understand that we will need to provide proof of legal water supply, a PWSID number, and/or a well permit prior to approval of our Site Development Plan.

Comment 4. *JCPH advises all parties to note that the long-term dependability of any water supply in Colorado, be it surface water, ground water, or a combination of surface water and ground water, cannot be guaranteed. All ground water and surface water supplies are subject to fluctuations in*

precipitation. During periods of drought, it will be necessary to carefully manage all uses of water so that the basic water supply needs for human health can be met.

Response: Comment noted. During our site development planning, we will work with the County and local water entities to better understand water availability in the area and will reduce our proposed usage where possible. We also have considered alternatives for water supply, such as hauling water, that we could employ during periods of need.

II. Wastewater

Comment 1. *The applicant submitted a partially completed Onsite Wastewater Report (Form 6001) in accordance with LDR Section 22.B.2. (a) on the March 2023 referral. The second page of the form was not provided as required.*

Response: The Onsite Wastewater Report (Form 6001) that we included in our initial application submittal included both the front page of Form 6001 and page 1 of 1 of Form 6001; however, we see that we used a previous version of the form which was last revised in 7/27/2017. We have included an updated Onsite Wastewater Report (Form 6001, last revised 11/15/2021) in this second referral resubmittal package and attached to the updated OWTS Engineer Report.

Comment 2. *An Engineering Study for Shadow Mountain Bike Park Concept Master Plan Wastewater System Improvements prepared by Stantec dated November 2022 Project No. 181711248 was provided for review. This study calculated that the average day usage is estimated to be 1120 gallons per day (gpd) for the maximum occupancy at full build out for 320 persons.*

Response: This was correct; however, the report has been updated based on your comments and is no longer true. Refer to the following comment and the OWTS Engineer Report included with our resubmittal package for more information.

Comment 3. *The submitted Shadow Mountain Bike Park Official Development Plan indicates that there will be up to a maximum of 1,200 guests per day. Using Appendix A, Estimated Daily Wastewater Flow, of the current Jefferson County Onsite Wastewater Regulations and the amended number of guests from 300 to 1,200 per day, we estimate that approximately 6,000 gallons of wastewater will be generated per day by guests and at a minimum of 300 gallons per day (gpd) for employees. See following table: [refer to Letter for table]*

Response: From our work with the Planning and Zoning Engineering Geologist and our case manager and additional data supporting our estimated water use of 4 gpd per guest, we have updated both the water and wastewater supply items in our application, both of which are included in this resubmittal package. This estimates approximately 4,320 gpd of wastewater for guests and employees. Refer to the water and wastewater reports for more information.

Comment 4. ***As such, the onsite wastewater treatment system(s) exceed the average daily flow of 2,000 gallons per day or more per property and must comply with the Colorado Water Control Act, Article 8, Title 25 of the Colorado Revised Statutes, and Regulations adopted by the Colorado Water***

Quality Control Commission. Site approval from the Colorado Department of Public Health and Environment is required prior to the approval of this site development plan. Jefferson County Public Health will provide review and comment to the Colorado Department of Public Health and Environment on the site application as requested. The applicant must contact the CDPHE, Water Quality Division at 303.692.3500.

Response: Comment noted. We understand that prior to approval of the Site Development Plan, the CDPHE and JCPH will need to review and comment on our plans for an OWTS given the daily treatment requirements of 4,320 gpd as described in the wastewater report. If this is necessary prior to approval of this Special Use Plan/ODP, please let us know.

Comment 5. Depending on the type of food service provided in the guest day lodge, the discharge to the OWTS may be required to be calculated into the total gallons of wastewater generated per day. This must be provided to the CDPHE, Water Quality Division as part of the Site Application.

Response: As described above, food service would not include kitchen space so is not included in the discharge to the OWTS.

III. Environmental Assessment

Comment 1. JCPH has reviewed the Environmental Questionnaire and Disclosure Statement. The applicant checked "No" on all categories of environmental concern on the cover sheet. From this information, it does not appear that any recognized environmental conditions exist which would negatively impact the property.

Response: Comment noted.

IV. Regulated Facilities

Comment 1. The applicant indicated in March 2023 that food and beverages would be provided from Food Trucks at this site for retail food service for guests. The submitted Shadow Mountain Bike Park Official Development Plan states that pre-made food and beverages will be served at the day lodge.

Comment 2. The proposed retail food service establishment may be subject to a plan review, yearly licensing and routine inspections by this Department. Please email health_eh_rf_plan_review@jeffco.us for specific requirements. "Retail food establishment" means a retail operation that stores, prepares, or packages food for human consumption or serves or otherwise provides food for human consumption to consumers directly or indirectly through a delivery service, whether such food is consumed on or off the premises or whether there is a charge for such food Colorado Revised Statutes 25-4-1602(14).

Response: Comments noted. In this letter and in our ODP, we have clarified our definition of Food and Beverage Vendors. If this application is to be approved, we will proceed with additional plans for licensing and inspections and meeting other requirements listed herein.

V. Maintenance Facilities

Comment 1. Above ground storage fuel tanks with total tank capacity of 660 to 40,000 gallons are regulated by the Colorado Department of Labor and Employment, Division of Oil and Public Safety. They may also be regulated by the local fire department. Above ground storage tanks should also have underground piping for fuel is associated with the above ground storage tank, this may also be regulated by CDLE. Contact the CDLE, Division of Oil and Public Safety at 303.318.8500 and the jurisdictional fire department for registration, permitting, inspection and monitoring requirements.

Comment 2. Hazardous materials (oil, maintenance equipment fluids, etc.) or industrial waste that is generated from this operation cannot be disposed of into the onsite wastewater treatment system(s). Onsite disposal is prohibited. Any waste of this type must be recycled or disposed of at the proper waste disposal site, in accordance with local, state, and federal regulations.

Comment 3. Any waste materials generated from repair operations must be properly contained and stored on the site prior to transporting to an approved recycling or disposal facility. On site disposal of any such materials is prohibited. Sufficient control measures to prevent any spillage from impacting the area should be in place.

Response: Comments noted.

VI. Air

Comment 1. Land development projects that are greater or equal to 25 contiguous acres and/or 6 months in duration typically require the submission of an Air Pollutant Emission Notice (APEN) and may require an air permit. Furthermore, Regulation No. 1 of the Colorado Air Quality Control Commission requires the developer to follow a Fugitive Dust Control Plan to mitigate dust problems during demolition, land clearing and construction activities. This department will investigate any reports of fugitive dust emissions from the project site. If confirmed, a notice of violation will be issued with appropriate enforcement action taken by the State.

Response: Comment noted.

VII. Noise

Comment 1. The Colorado Revised Statutes (Sections 25-12-101 through 108) stipulate commercial areas must comply with the following maximum noise levels 25 feet from the property lines:

- 60dB(A) from 7:00 a.m. to 7:00 p.m.
- 55dB(A) at all other times.

Response: Comment noted. According to the Sensory Impact Assessment included in this resubmittal package, the Project would comply with County noise regulations as described above.

VIII. Note

April 12, 2024
Page 6

Comment 1. *These case comments are based solely upon the submitted application package. They are intended to make the applicant aware of regulatory requirements. Failure by Jefferson County Public Health to note any specific item does not relieve the applicant from conforming to all County regulations. Jefferson County Public Health reserves the right to modify these comments, request additional documentation, and or add appropriate additional comments.*

Response: Comment noted.

Sincerely,



Phil Bouchard
Shadow Mountain Bike Park

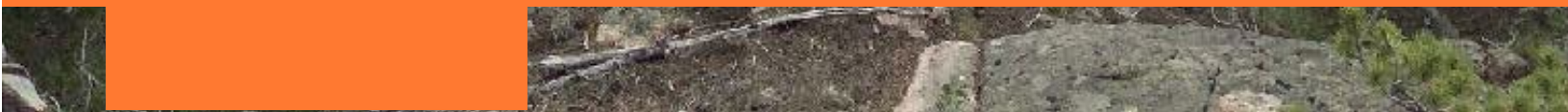


Jason Evans
Shadow Mountain Bike Park

THE
Ember
Alliance



Shadow Mountain Bike Park Wildfire Mitigation Hazard Plan



Prepared for:



Shadow Mountain Bike Park
FSBR LLC

- and -



SE Group
PO Box 2729
Frisco, CO 80443

Prepared by:



The Ember Alliance
PO Box 2084
Fort Collins, CO 80522

Table of Contents

1. Introduction	3
1.a. Site Visit.....	3
1.b. Management Area Maps and Desired Future Conditions	3
Management Area A.....	7
Management Area B.....	9
Management Area C.....	11
Management Area D.....	13
Management Area E.....	15
Management Area F.....	17
Management Area G.....	19
Management Area H.....	22
All Remaining Areas	22
2. References	23

1. Introduction

1.a. Site Visit

Staff at The Ember Alliance completed a site visit on September 20 and 21, 2023. A seasonal forestry crew walked the property assessing and delineating planned areas for mitigation and management. The visit also evaluated Shadow Mountain Drive between Highway 73 and the property, following the assessment guidelines in the Colorado State Forest Service (CSFS) Fuelbreak Guidelines document.

1.b. Management Area Maps and Desired Future Conditions

Eight management areas were delineated, along with descriptions of desired future conditions (DFCs) for each management area. These management areas and DFCs cover all the essential areas to treat to achieve SMBP’s goals for general wildfire mitigation and user safety. The remainder of the parcel does not have mitigation measures proposed because these areas were either not identified as having elevated wildfire risk or are intended to be monitored and

evaluated for treatment in future years. Additionally, leaving the remainder of the parcel as-is will help maintain the character of the surrounding landscape.

To define the DFCs, management objectives were first identified. This site is intended to be a recreational area within Jefferson County, so to be consistent with other recreational areas in Jefferson County, the management objectives for this site were defined as the same ones that Jefferson County Open Space uses in the [2022 Forest Health Plan](#). Ten objectives were identified, as follows:

1. Reduce risk of catastrophic wildfire
2. Reduce forest densities and canopy cover
3. Increase the presence, size, and diversity of forest openings
4. Restore and maintain a mosaic of ecosystems and vegetation cover across the landscape
5. Promote fine scale heterogeneity in tree spatial patterns
6. Protect and enhance old-growth features
7. Where appropriate, reestablish the use of prescribed fire as a management tool
8. Promote long-term ecosystem resilience to natural disturbance
9. Assist with ecosystem adaptation to climate change
10. Create aesthetically pleasing forest stands

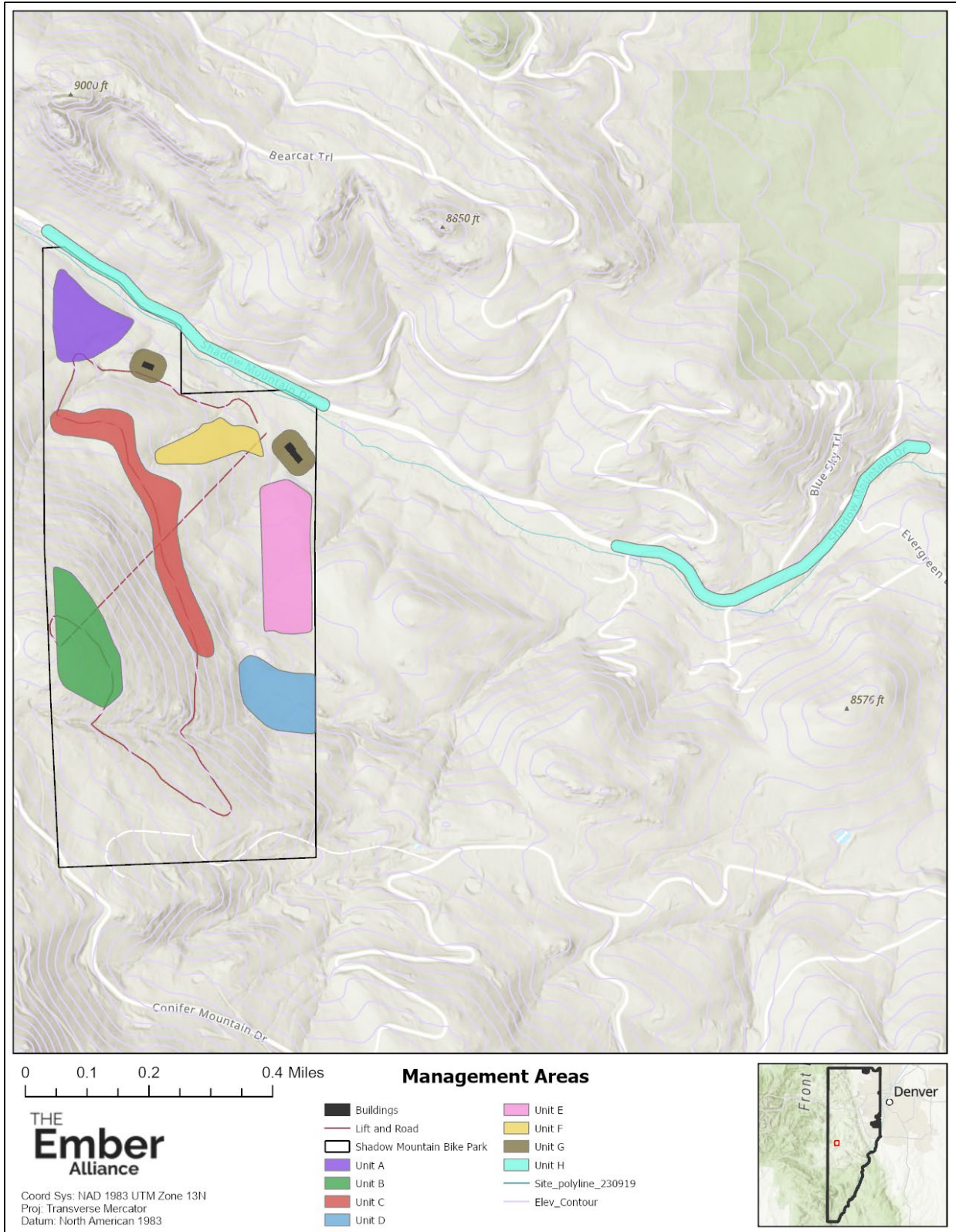


Figure 1. All Management Areas.

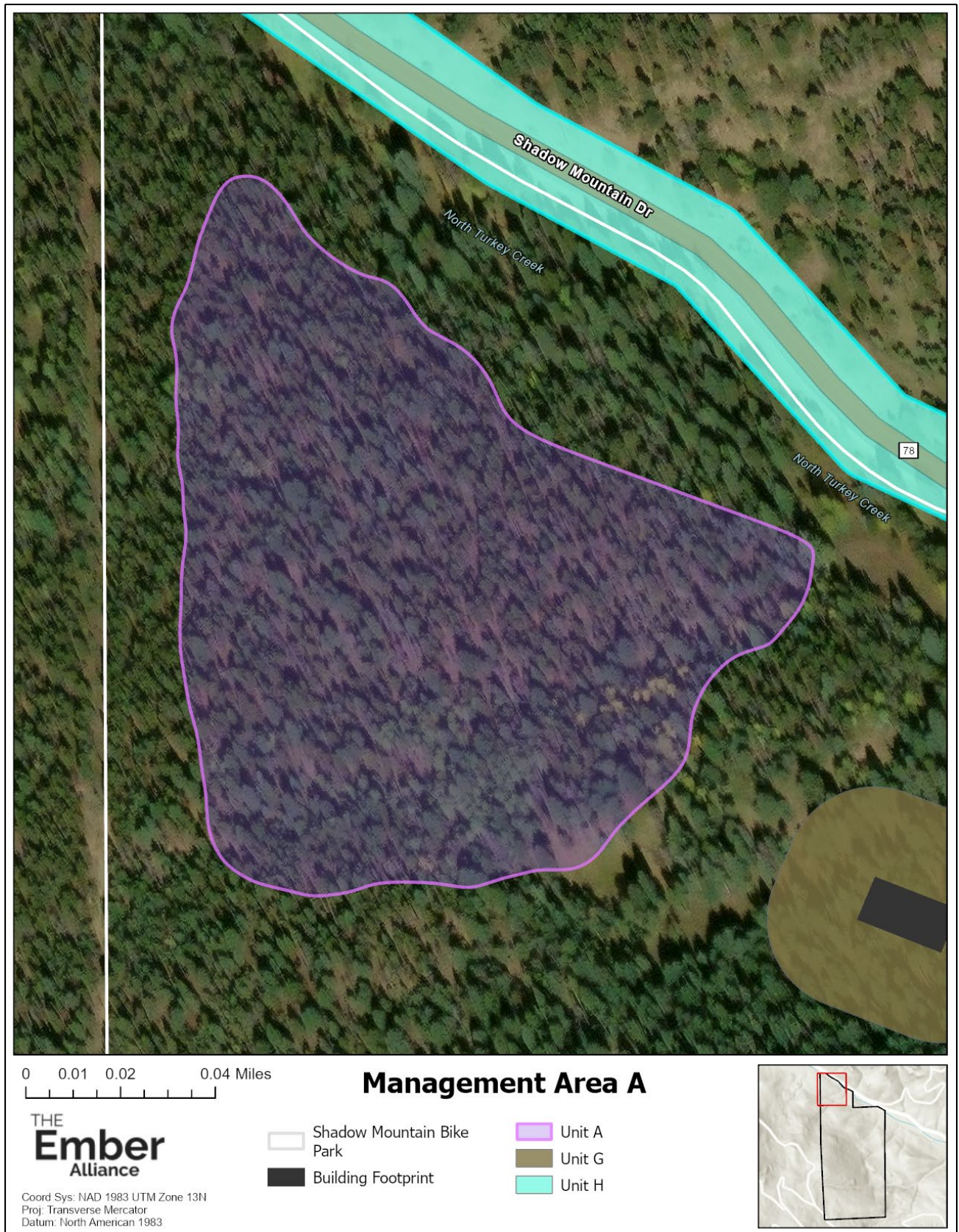


Figure 2. Management Area A.

Management Area A

Approximately 7.5 acres of mixed conifer and ponderosa pine forest.

Desired Future Conditions

Uneven-aged mixed conifer stands with occasional established ponderosa pine. Minimal ladder fuels are present, trees grouped with spacing between groups. Ponderosas have a wide spacing around their canopy. Occasional standing dead trees are retained as habitat trees.

Management Objectives Achieved: 1, 2, 3, 5, 6, 9, 10

Treatment

In Area A, all trees (excluding aspen) with a diameter at breast height (DBH) of 6 inches or under should be removed. All juniper and gamble oak should be removed. Occasional standing dead trees can be retained where they pose no risk to bikers.

Approximately 15-20% of trees with a DBH greater than 6 inches should be removed with an intent to isolate canopy groups. Retain all trees with a DBH greater than 20 inches, and favor removing smaller trees when possible. Favor retaining ponderosa pine to support climate adaptation within this ecosystem.

Limb (prune) all the remaining trees up to 10 feet from the ground. Work east as much as possible to preserve structures while maintaining a transition zone around the nearby private property/homes. Thin conifers as close as possible to the road and retain any aspen and willows near the river to support erosion control and stream health.

This area is best suited for selective hand thinning and chipping for slash management.

Treatment Return Interval

Evaluate the need for small diameter tree thinning and ladder fuel removal every 5 years.

Treatment re-entry needed to maintain forest health and historic conditions is estimated to be 8 to 23 years following the treatment. Regeneration can be dense and contribute to increased fire risk and intensity and should be actively managed and mitigated.

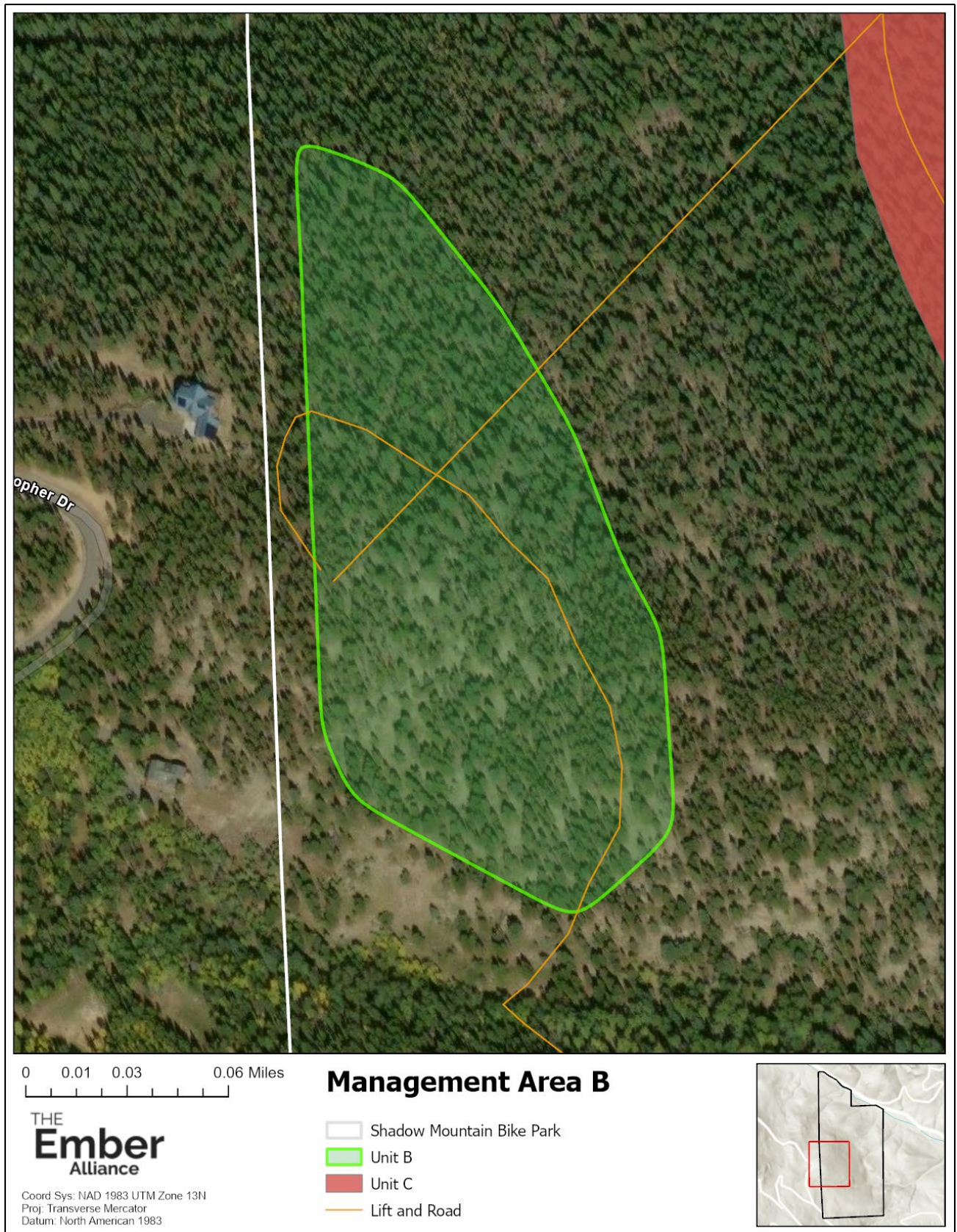


Figure 3. Management Area B.

Management Area B

Approximately 10.5 acres of mixed conifer and spruce-fir forest.

Desired Future Conditions

An uneven-aged mixed conifer/spruce-fir forest with groupings of trees. Conifer forests are maintained and moderately thinned to remove the most hazardous fuels but promote health and vigor of the remaining trees. Minimal ladder fuels are present, and there is enough open space to provide a view/outlook of the surrounding landscape. Trees in this area are in a stand that surrounds the “outlook” area. Trees are retained and managed to provide a visual buffer between the residences and the chairlift. Occasional standing dead trees are retained as habitat trees.

Management Objectives Achieved: 1, 2, 3, 5, 6, 7, 8, 10

Treatment

In Area B, all trees with a diameter at breast height (DBH) of 6 inches or under should be removed. All juniper and gamble oak should be removed. Occasional standing dead trees are retained where they pose no risk to bikers.

All trees with a DBH greater than 6 inches should be removed with the intent to isolate canopy groups. Retain all trees with a DBH greater than 20 inches, and favor removing smaller trees when possible.

Limb all the remaining trees up to 10 feet from the ground. Remove shrubs and ladder fuels under the trees. Maintain a transition zone to the private property.

This area is best suited for mechanical thinning and pile building for slash management.

Treatment Return Interval

Evaluate the need for small tree thinning and ladder fuel removal every 5 years. Treatment re-entry needed to maintain forest health and historic conditions is estimated to be 8 to 23 years following the treatment. Tree regeneration can be dense and contribute to increased fire risk and intensity and should be actively managed and mitigated.

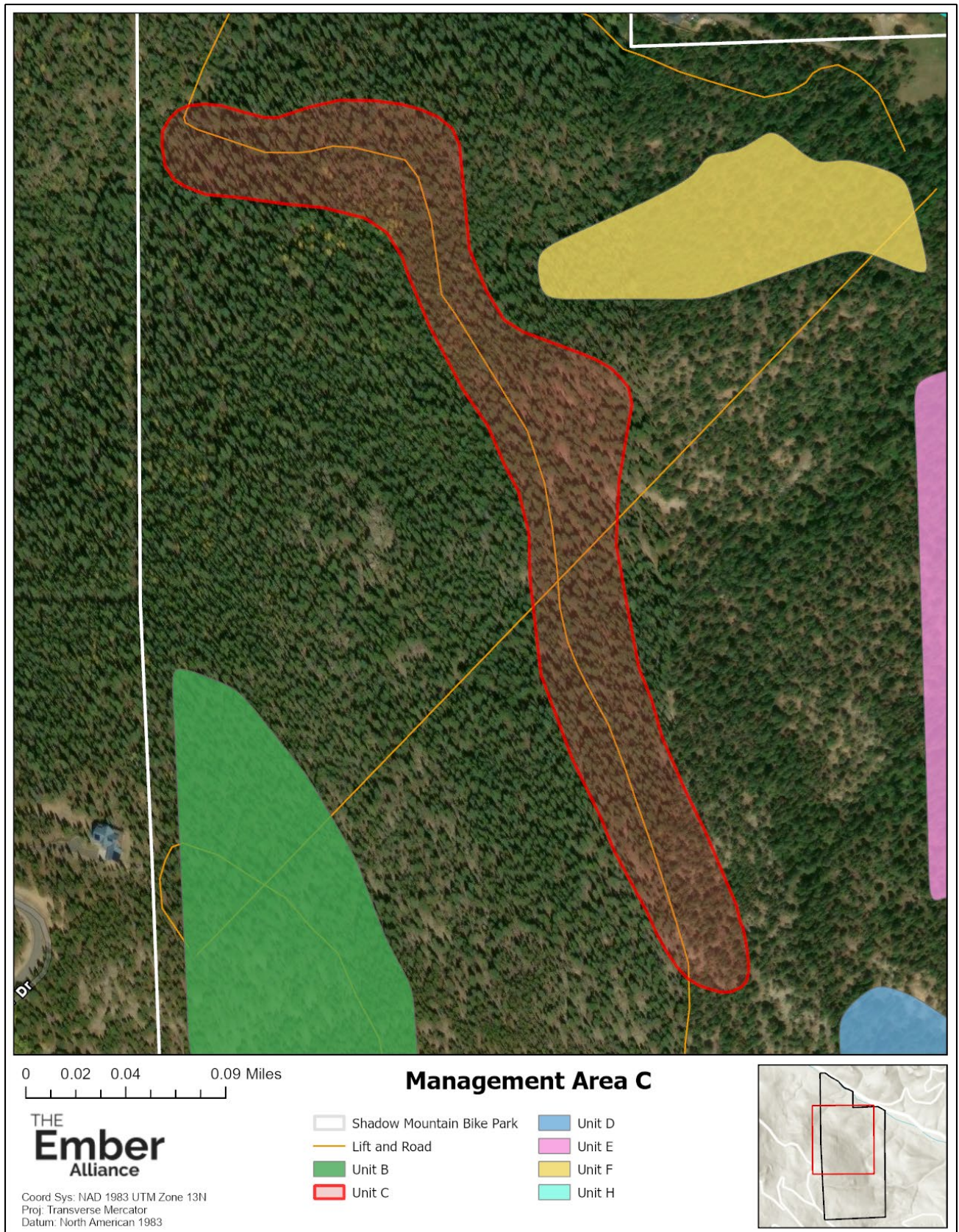


Figure 4. Management Area C.

Management Area C

Approximately 14 acres of mixed conifer, spruce-fir, and ponderosa pine forest.

Desired Future Conditions

A fuel break along the maintenance road/base of the steep slope of the mixed conifer forest. Minimal ladder fuels are present, with wide spacing between tree crowns/groupings of tree crowns. Standing dead trees are not retained.

Management Objectives Achieved: 1, 2, 3, 5, 6, 8, 10

Treatment

In Area C, all trees (excluding aspen) with a diameter at breast height (DBH) of 6 inches or under should be removed. All juniper and gamble oak should be removed.

Approximately 15-20% of trees with a DBH greater than 6 inches should be removed with an intent to isolate canopy groups. Retain all trees with a DBH greater than 20 inches, and favor removing smaller trees when possible.

Limb all the remaining trees up to 10 feet from the ground. Remove ladder fuels/shrubs under the trees.

This area is best suited for selective hand thinning and chipping for slash management.

Treatment Return Interval

Evaluate the need for small tree thinning and ladder fuel removal every 5 years. Treatment re-entry needed to maintain forest health and historic conditions is estimated to be 8 to 23 years following the treatment. Tree regeneration can be dense and contribute to increased fire risk and intensity and should be actively managed and mitigated.

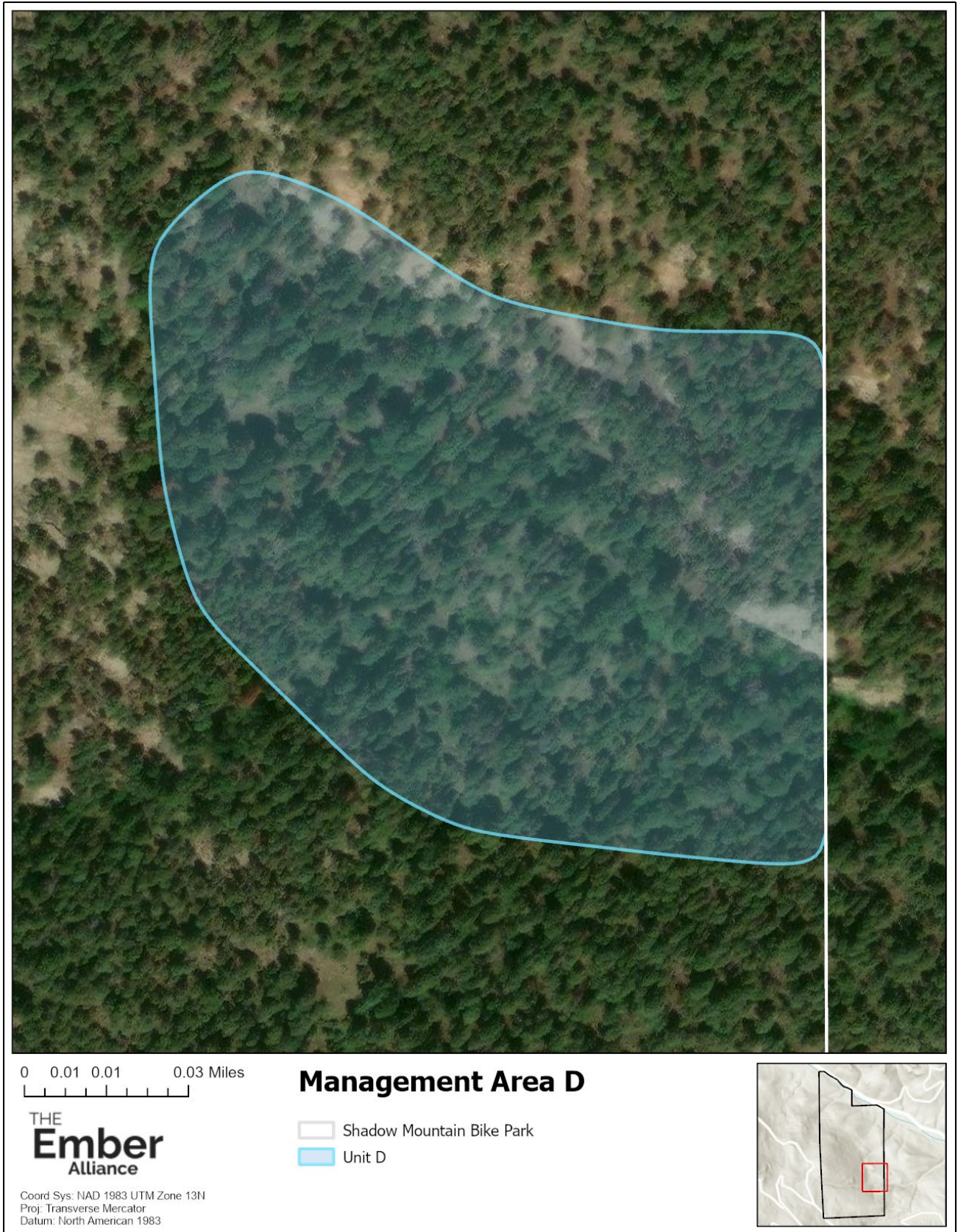


Figure 5. Management Area D.

Management Area D

Approximately 7.5 acres of lodgepole pine forest with some fir.

Desired Future Conditions

Mosaic stands of lodgepole pine. Each stand is even-aged but there is age diversity between the stands. Patch cuts mimic historic fire in this forest type, which would replace entire stands with each fire event. To protect the aesthetic and habitat value of the lodgepole pine area, smaller patch cuts are completed, rather than larger cuts.

Management Objectives Achieved: 1, 2, 3, 4, 5, 6, 8, 9, 10

Treatment

In Area D, patch cut in 3-acre sections, focusing along the west flank until the lodgepole stand gets too steep to cut. Patch cuts remove all sizes and species of trees except aspen, which are retained. Occasional standing dead trees may be retained, if present. The steepness of the site may limit the work that a crew can complete.

This area is best suited for hand crew cutting and pile building/burning for slash management.

Treatment Return Interval

After the initial 3-acre patch cut is completed, that stand is permitted to regenerate without thinning for at least 75 years (the lower end of their historic fire return interval). A second or third entry for patch cuts in other sections of this management area can be completed in the decades following the initial cut. Age diversity between the patch cuts is important as it creates habitat diversity and a mosaic landscape that is more resilient to wildfire. Stands should not frequently reach an average age beyond 300 years, which is the upper end of their fire return interval.

If the land managers have the resources, additional 3- to 6-acre patch cuts can be completed with the same objectives and DFCs in the southwest corner of the property. The north-facing hillside on the very south side of the property can be treated for additional fuels mitigation and habitat diversity.

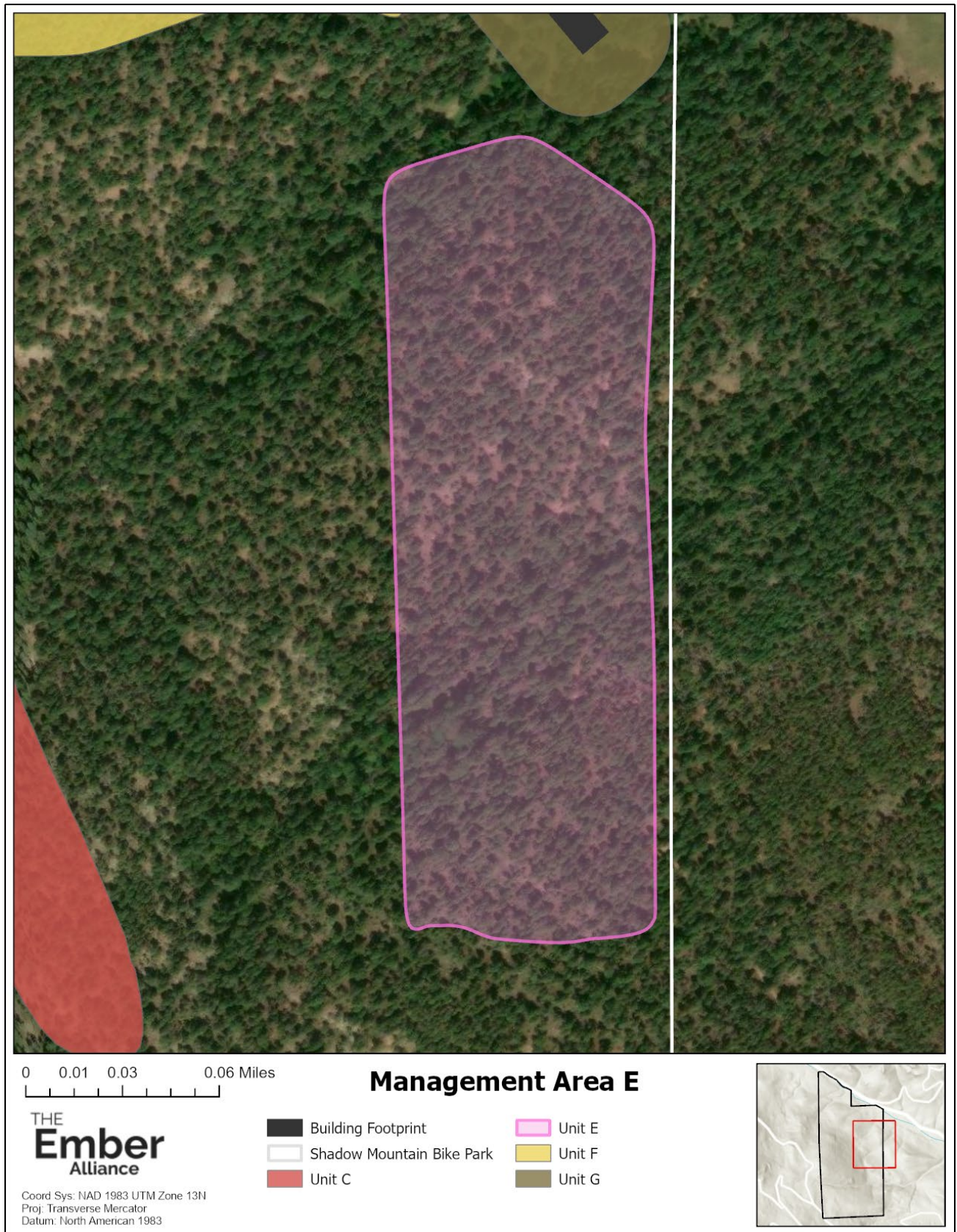


Figure 6. Management Area E.

Management Area E

Approximately 12 acres of mixed conifer forest with aspen.

Desired Future Conditions

An uneven-aged mixed conifer forest with increasingly large aspen stands. Conifer forests are maintained and moderately thinned to remove the most hazardous fuels but promote health and vigor of the remaining trees. Aspen is favored and allowed to grow freely, becoming old growth in time. Small forest openings are present between aspen and conifer, and between groupings of conifers. Minimal ladder fuels are present in the coniferous areas and occasional standing dead trees are retained as habitat trees.

Management Objectives Achieved: 1, 2, 3, 4, 5, 6, 8, 9, 10

Treatment

In Area E, all trees (excluding aspen) with a diameter at breast height (DBH) of 6 inches or under should be removed. All juniper and gamble oak should be removed. Occasional standing dead trees are retained where they pose no risk to bikers.

Approximately 15-20% of trees with a DBH greater than 6 inches should be removed with an intent to isolate canopy groups, cutting smaller trees when possible.

Limb all the remaining trees up to 10 feet from the ground. Remove shrubs and ladder fuels under trees.

This area is best suited for selective hand thinning and pile building/burning for slash management.

Treatment Return Interval

Evaluate the need for small tree thinning and ladder fuel removal every 5 years. Treatment re-entry needed to maintain forest health and historic conditions is estimated to be 8 to 23 years following the treatment. Tree regeneration can be dense and contribute to increased fire risk and intensity and should be actively managed and mitigated.

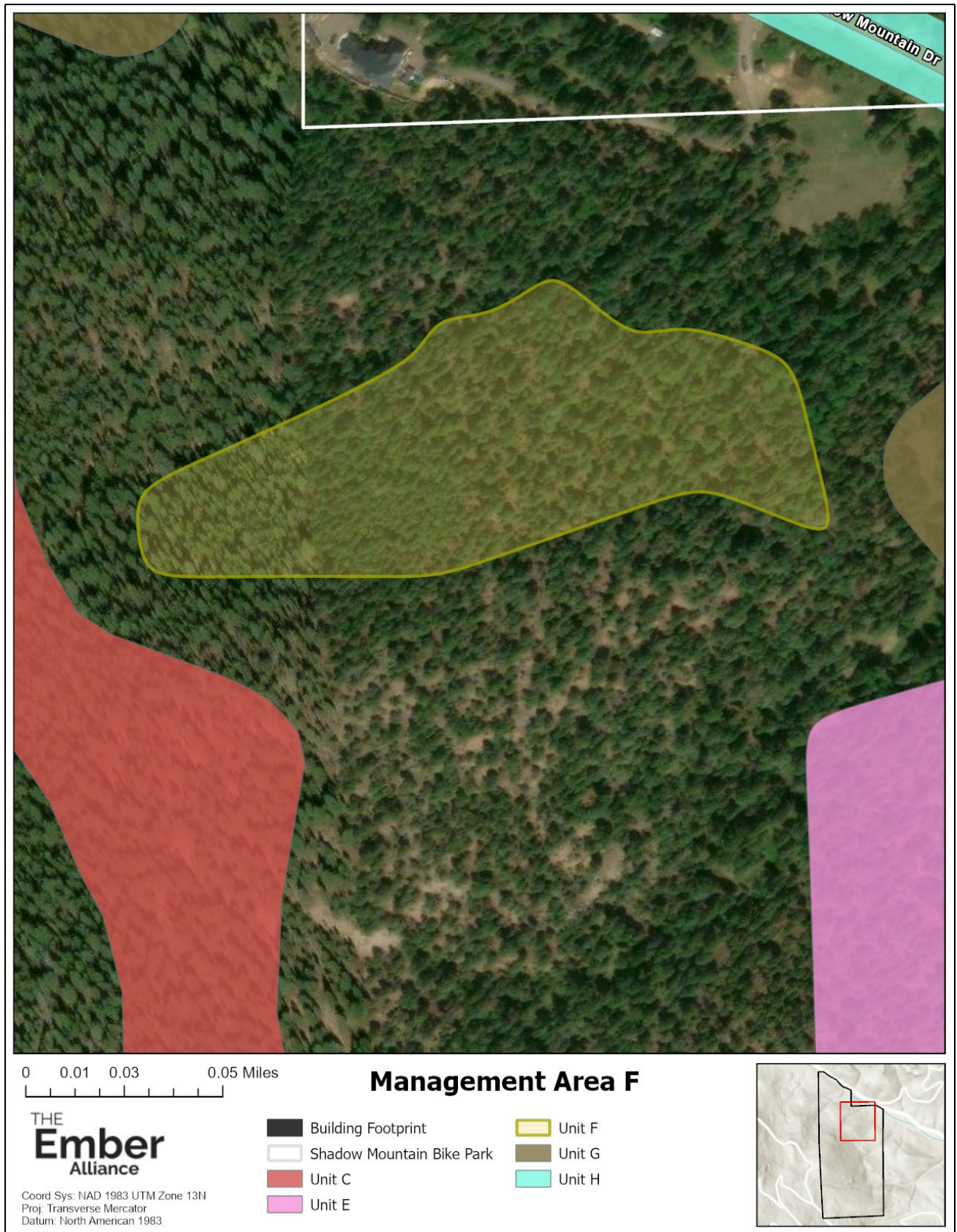


Figure 7. Management Area F.

Management Area F

Approximately 5 acres of mixed conifer forest with aspen.

Desired Future Conditions

An uneven-aged mixed conifer forest with increasingly large aspen stands. Conifer forests are maintained and thinned to remove the most hazardous fuels but promote health and vigor of the remaining trees. Aspen is favored and allowed to grow freely, becoming old growth in time. Small forest openings are present between aspen and conifer, and between groupings of conifers. Minimal ladder fuels are present in the coniferous areas and occasional standing dead trees are retained as habitat trees.

Management Objectives Achieved: 1, 2, 3, 4, 5, 6, 8, 9, 10

Treatment

In Area F, all trees (excluding aspen) with a diameter at breast height (DBH) of 6 inches or under should be removed. All juniper and gamble oak should be removed.

Approximately 15-20% of trees with a DBH greater than 6 inches should be removed with an intent to isolate canopy groups. Retain all trees with a DBH greater than 20 inches, and favor removing smaller trees when possible.

Limb all the remaining trees up to 10 feet from the ground. This area is very dense with lots of saplings. Maintain a transition zone around the nearby private property/homes.

This area is best suited for selective hand thinning and chipping and/or pile building for slash management.

Treatment Return Interval

Evaluate the need for small tree thinning and ladder fuel removal every 5 years. Treatment re-entry needed to maintain forest health and historic conditions is estimated to be 8 to 23 years following the treatment. Tree regeneration can be dense and contribute to increased fire risk and intensity and should be actively managed and mitigated.



Figure 8. Management Area G.

Management Area G

Approximately 3.5 acres of mixed conifer forest with aspen.

Desired Future Conditions

Structures have home hardening measures taken to be ignition resistant. No vegetation within 5 feet of the structures. Minimal, potentially irrigated vegetation within 30 feet of the structures. Minimal vegetation with wide spacing and no ladder fuels within 100 feet of the structure.

Management Objectives Achieved: 1, 2, 3, 4, 5, 10

Treatment

Zone 1: From 0-5 feet from the edge of the buildings, install concrete, gravel, or another non-flammable groundcover.

Zone 2: From 5-30 feet, there should be no more than 20 trees total left within this zone around the maintenance facility and no more than 30 around the lodge (assuming an average tree crown spread of 30 feet). We recommend aiming for approximately half that number to err on the side of caution, leaving no more than 10 and 15 trees, respectively. If there are aspens, those should be selected to remain over any other species. All trees should have a minimum of 10 feet of spacing between the crowns. If trees are planted following the building construction, include the anticipated crown diameter in this plan. Remove any dead, dying, or diseased trees.

Mow all grasses regularly to keep the height no more than 4 inches. Irrigation is recommended but not necessary, due to water constraints and the desire for a natural aesthetic.

All remaining trees should be limbed (pruned) to a height of 10 feet. This means the distance from the ground to the bottom of the lowest part of the lowest hanging branch.

All juniper and gamble oak should be removed. Any other remaining shrubs, such as mountain mahogany or chokecherry, can remain if they are not under trees or tree canopies. Shrubs should be isolated and not be allowed to grow in groups or continuous clusters.

Zone 3: From 30-100 feet from the end of the structures, there should be no more than 36 trees total left within this zone around the maintenance facility and no more than 48 around the lodge (assuming an average tree crown spread of 30 feet). We recommend aiming for approximately half that number to err on the side of caution, leaving no more than 18 and 24 trees, respectively. If there are aspens, those should be selected to remain over any other species. All trees should have a minimum of 10 feet of spacing between the crowns. Remove any dead, dying, or diseased trees.

The remaining trees should be limbed to a height of 10 feet. This means the distance from the ground to the bottom of the lowest part of the lowest hanging branch. Remove any shrubs that are under tree canopies.

This area is suitable for mechanical or hand thinning. Any and all slash, woody debris, or other flammable material should be removed entirely from these zones. They can be hauled off site or masticated and spread outside the zones.

Treatment Return Interval

Annual maintenance of each of these areas is required.

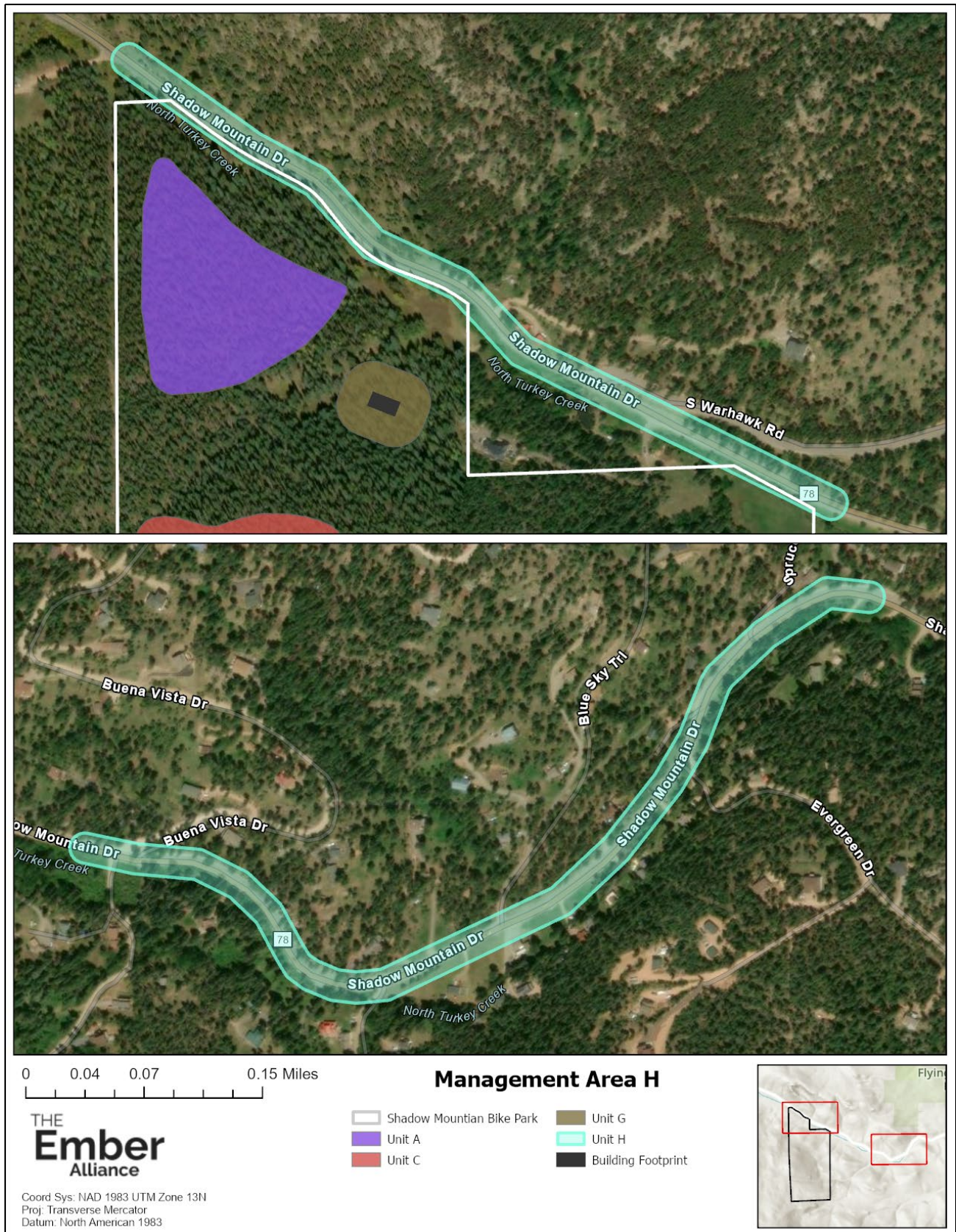


Figure 9. Management Area H.

Management Area H

Approximately 1.25 miles of road. The crowning potential in this area ranges from 3-9, designating it as an area in need of treatment and mitigation.

Desired Future Conditions

The road has space to either side of the lanes that is open enough to keep the flame length down to 8 feet or less. Evacuating residents and incoming firefighters have adequate space to drive and turn around engines without endangering their passengers.

Crowning potential, when assessed to the same CSFS Fuelbreak Guideline standards, should be a 3 or below following the treatment.

Management Objectives Achieved: 1, 2, 3, 4, 5, 6, 8,

Treatment

In Area H, remove all trees (excluding aspen) within 15 feet of the side of the road, where possible. Beyond that, thin trees according to the CSFS Fuelbreak Guidelines document along the identified portions of Shadow Mountain Drive. This involves creating 10 feet of space between crowns and removing ladder fuels under and between the trees. Favor retaining larger and older trees, as well as retaining aspen or other riparian species, where they are present. The slope from the roadways is generally between 20-40%, indicating that an ideal fuelbreak distance from the edge of the road would be 110-130 feet. This distance likely crosses into private land and is therefore not accessible. The treatment recommendation is that the fuelbreak is mitigated as far from the road as is feasible using the county-owned land and right-of-way easements.

This area is best suited for selective hand thinning and/or use of a roadside masticator head and chipping for slash management.

Treatment Return Interval

Tree regeneration in opened stands such as initial fuelbreak cuts can be dense and contribute to increased fire risk and intensity. This should be actively managed and mitigated over time through follow up treatments. Evaluate the need for thinning, regeneration removal, and ladder fuel removal every 3 years. This is a shorter evaluation time than other management areas due to the life safety aspect of this treatment.

All Remaining Areas

No mitigation action is recommended for the remaining forest areas. We recommend that they be monitored and managed for forest health and that the mitigation plan be revisited in approximately 15 years.

Citation: The Ember Alliance. 2023. *Shadow Mountain Bike Park Wildfire Mitigation Hazard Plan*. Fort Collins, CO.

2. References

Colorado Forest Restoration Institute. 2021. Fires behavior differently in different forest types [WWW Document]. Colorado State University, Colorado Forest Restoration Institute. <https://cfri.colostate.edu/wp-content/uploads/sites/22/2021/01/FireEd-Infographic-Web-Print-1.pdf>

Colorado Forest Restoration Institute. 2022. 2022 Jefferson County Open Space Forest Health Plan. Colorado State University, Colorado Forest Restoration Institute. <https://www.jeffco.us/DocumentCenter/View/33433/JCOS-Forest-Health-Plan-DRAFT>

Colorado State Forest Service 2021. The home ignition zone: A guide to preparing your home for wildfire and creating defensible space. Colorado State University, Colorado State Forest Service. Fort Collins, CO. <https://csfs.colostate.edu/wp-content/uploads/2021/04/2021-CSFS-HIZGuide-Web.pdf>

Dennis, F.C. 2005. Fuelbreak guidelines for forested subdivisions and communities. Colorado State University, Colorado State Forest Service, Fort Collins, CO.

Hunter, M.E.; Shepperd, W.D.; Lentile, J.E.; Lundquist, J.E.; Andreu, M.G.; Butler, J.L.; Smith, F.W. 2007. A comprehensive guide to fuels treatment practices for ponderosa pine in the Black Hills, Colorado Front Range, and Southwest. Gen. Tech. Rep. RMRS-GTR-198. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 93 p. https://www.firescience.gov/projects/05-S-03/project/05-S-03_05_S_03_Deliverable_02.pdf

U.S. Forest Service. 2012. Spruce-fire Forest Desired Condition. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5409830.pdf



April 12, 2024

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Shadow Mountain Bike Park - Case No. Case No. 23-102980 RZ

Dear Mr. Monke,

We are in receipt of the Second Referral Response Letter from Jefferson County Historical Commission (“JCHC”), dated January 22, 2024, as part of the second referral of the application for a special use for the Shadow Mountain Bike Park project (the “**Application**”). We understand that we have satisfied a number of the JCHC’s recommendations from their First Referral Response Letter dated May 10, 2023. After further consideration and review of additional information provided by a local resident, the JCHC responded to our Second Referral by recommending the following:

Recommendation 1. A Historical, Archaeological and Paleontological Report/(Plan) shall be prepared in accordance with Land Development Regulation, Section 31 and shall address the alternatives for protection of any historical, archaeological and/or paleontological sites. Once the Historical, Archaeological and Paleontological Plan is completed and approved, if historical, archaeological and paleontological resources are present or discovered during site preparation, the applicant shall notify the Jefferson County Planning and Zoning Division to determine the disposition and necessary protection, excavation, or recovery of the resource(s).

Recommendation 2. The mountain and historic landscape are basically intact throughout the project area. JCHC will work with the applicant to consider this landscape during project design and developing mitigation measures.

Recommendation 3. Although the applicant is not required to conduct an on-the-ground survey, JCHC believes it is the most reliable approach for identifying cultural resources and reducing potential impacts to them during planning and not during development, which can result in project delays and unnecessary damage to cultural resources.

In response to these recommendations, we scheduled a meeting with the JCHC to better understand their expectations and establish next steps. In the meeting, we discussed our commitment to an on-the-ground survey in certain parts of the project area and suggested delaying the preparation of an Historical, Archaeological, and Paleontological Report/Plan until the design/development phase, since a report would be prepared to describe the project area and survey results at that point anyway. In the meeting, JCHC was willing to consider these next steps and accept a response letter (this letter) instead of a Report/Plan in this referral. Lastly, we discussed next steps, and from that conversation, we commit to the following measures:

- We will prepare a Historical, Archaeological, and Paleontological Report/Plan in accordance with Land Development Regulation, Section 31. The information required according to LDR Section 31 will be included in the report that follows cultural surveys as required per Section 106 compliance.
- We are committed to conducting cultural surveys in areas with higher levels of ground disturbance, which includes: the driveway, parking lot/base area, and area around the top of the chairlift.
- We would like to invite a member of JCHC to assist in the flagging of trail alignments during the design and development phase to determine the presence (or likelihood therein) of cultural resources, if necessary.
- If historical, archaeological and paleontological resources are discovered during site preparation or construction, all construction in the immediate vicinity shall cease and the applicant shall notify the Jefferson County Planning and Zoning Division and the proper authorities to determine the disposition and necessary protection, excavation, or recovery of the resource(s).

We understand the importance of preserving historical, archaeological, and paleontological resources and is committed to prioritizing the protection of resources, if present within the project area. If the Application is approved by the County, we would work with the Jefferson County Historical Commission, the Conifer Historical Society, and other cooperating agencies to fulfill the requirements for this resource, establish mitigation measures where necessary, and continue the project planning accordingly.

Sincerely,



Phil Bouchard
Shadow Mountain Bike Park



Jason Evans
Shadow Mountain Bike Park



April 17, 2024

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Shadow Mountain Bike Park - Case No. Case No. 23-102980 RZ

Dear Mr. Monke,

We are in receipt of the Long Range Review Memo from Jefferson County Planning and Zoning, dated February 2, 2024, as part of the second referral of the application for a special use for the Shadow Mountain Bike Park project (the "Application"). With this letter, we are providing the following responses to comments received.

I. Key Issues

Land use, wildfire, wildlife, floodplain, light, noise, visual impacts.

Response: Key issues noted.

II. Land Use

1. *The property is located within the Conifer/285 Corridor Area Plan. The properties are within an area recommended for 1 dwelling unit per 10 acres.*

Since this is a Class III Commercial Recreation Facility, it would not fit into the definition of a Community Use. Therefore, the applicant needs to address the three factors outlined below to be considered when a new development is not consistent with the land use recommendations. The applicant did provide a separate document titled "Evaluation for Applications out of conformance with CMP Analysis", however, that document did not specifically address All Development, Policy 3.

- 1.a *How the impacts associated with the proposed land use(s) will be mitigated compared with the recommended Land Uses;*

- *The recommended land use is 1 du/10 acres. The proposed land use is a Class III Commercial Recreation Facility. Some potential impacts that should be evaluated include wetland areas, floodplains, wildfire, wildlife, visual, light, noise, traffic, water and wastewater.*
- *See appropriate sections below for additional evaluation on each of these items.*
- *The applicant's evaluation of this item is in the Sufficiency Response Letter. They compare the visual impact and water use to the recommended land use of 1 du/10 acres.*

April 17, 2024

Page 2

- **Staff Continues to have concerns about how the impacts to wildfire, wildlife, and noise will be addressed.**

Response: We have considered the concerns listed throughout this document and have proposed additional restrictions and mitigation measures in order to reduce the Project's impact on the Property and surrounding uses. These documents are listed in response to each relative comment below.

1.b *How the proposed land uses are compatible with the surrounding Land Use Recommendations and community character; and*

- *The applicant notes that the current land use recommendation map contains areas of open space adjacent to large lot residential uses. They also note that they are concentrating infrastructure near Shadow Mountain Drive, while buffering the visual impact and will disperse the trail system throughout the property to be shielded from Shadow Mountain Drive. They state that the project will benefit the residences in the area by providing opportunities for improved health and economic growth and that this would offset mountain bike users from other existing areas.*
- *Evaluation of Special Use criteria 1 is in the document provided by the applicant and that criteria also discusses compatibility with existing and allowable land uses in the surrounding area. The applicant's analysis states that the surrounding neighborhoods are single-family dwellings at a moderate to low density. The applicant states that they intent to mirror that dispersed development with limited infrastructure by concentrating infrastructure at the base area and dispersing the trail system throughout the property.*
- **Staff agrees that open space uses and large lot residential uses are generally compatible. However, most open space parks offer more passive recreational activities, rather than active recreation that is being proposed at this location. While active recreation is also many times compatible with surrounding uses, impacts to adjacent neighbors, due to increased intensity of uses, still needs to be mitigated. Many of the items mentioned throughout the document would increase compatibility of this proposal with surrounding residential uses**

Response: We have proposed a number of mitigation measures to increase the compatibility of the Project with surrounding residential uses, including lighting and noise restrictions, limitations on parking capacity, limitations on visitation and facility size, and tracking measures for management. We acknowledge that the proposed use does not equate to residential use and is a more active use of the property; however, we also recognize that there are a number of benefits to the proposed use, particularly by providing outdoor

April 17, 2024

Page 3

recreation access for surrounding residences, a lower density development than residential lot uses, and additional services and jobs contributing to the local economy. The more active management proposed at SMBP would have a number of benefits for users and neighbors as well, through offerings such as better-maintained facilities and education/training programs.

Additionally, while SMBP may provide a more active use, daily activity at the park would be similar to activity nearby JCOS and State Parks in the area. Specifically, while the park itself would host a more active recreation experience by offering lift-served riding, the experience of neighbors through the ebb and flow of traffic as well as the activity within the entry portal would be similar to that at other parks. These parks in the vicinity of SMBP (including Staunton State Park and Flying J Ranch Park) are also located adjacent to residential areas, which exemplify the compatibility of residential and recreational uses to coexist.

1.c *What change of circumstance has occurred in the local area since the Land Use Recommendation was adopted.*

- *The applicant has revised their response to this factor to note that COVID increased trail use and in turn created more conflict on existing trails. They also noted the Outside 285 Plan created by the Colorado Mountain Biking Association, which includes objectives for an enhanced visitor experience and trail opportunities within or adjacent to existing trail systems and improve capacity and manage conflict in congested areas. Lastly, they noted the 2022 JCOS Forest Health Plan and how the development of this park would include wildfire treatment that would be in alignment with that Plan.*
- ***The Outside 285 Plan was created in collaboration with the Colorado Mountain Biking Association, Colorado Parks and Wildlife and the Pike National Forest, South Platte Ranger District. There was public engagement done with the plan, although since it was completed during the COVID pandemic, it was limited to virtual engagement. The plan does talk about how it is a strategy for trail development, not a decision document. It looked at opportunities Jefferson, Park and Douglas Counties. While wildlife impact have been brought up as an issue with this specific case, the Plan's evaluation was that this area is a low sensitivity habitat area. However, Core Habitat Areas did include riparian areas. It is unclear exactly how far it is recommended that a trail be from a riparian area, but it looks like if trails are within 25 m of a stream, then they are within the typical disturbance buffer.***
- *130 trail and trailhead improvement projects were analyze with this plan, it does not look like this proposal was analyzed as a part of this plan, so it may be difficult to make a direct correlation between the plan and this project.*

April 17, 2024

Page 4

- ***The Plan does contain some objectives specifically for the Evergreen-Conifer area. Those objectives include improve capacity and manage conflict in congested areas, providing backcountry trail experience and peak access in environmentally suitable locations, and encouraging private land conservation to project some of the few remaining undeveloped areas. There were some areas specifically mentioned in the objectives, but that did not include the Shadow Mountain Drive Area. Page 37 includes a map of projects analyzed and the Shadow Mountain bike park is not one of those projects. When staff has accepted a plan update as a change in circumstance in the past it has typically because the Plan shows or discusses the property specifically under review. So while there are general objectives that my generally support this use, staff still needs to evaluate it based on all of the other goals and policies in the Comprehensive Master Plan.***

Response: Noted. We have adjusted the change of circumstance response as follows:

Our team is thankful for the opportunity to discuss this topic, as changing circumstances in Jefferson County and the Conifer Area were a major influence in the inception of our project. In 2020, Phil Bouchard and Jason Evans started the SMBP project in response to overcrowding on public trails in Jefferson County. Their anecdotal experience as heavy users of public trail networks in the County led them to believe that trail user groups were growing significantly faster than public trail infrastructure could accommodate. Mountain bikers are putting the most pressure on public trail networks due to the increase in participation of the sport in recent years and user conflict issues with hikers have led to this group being the most in need of dedicated trail infrastructure. We recognize that the parcel where we're proposing to site SMBP has a land use recommendation of residential; however, many changes have occurred in Jefferson County and in the Conifer Area since the original adoption of the Jefferson County Comprehensive Master Plan. These changes in circumstance include an increased demand for recreation and dedicated trail infrastructure for mountain biking and increased support for these opportunities from local land managers and stakeholders.

Need for Additional Recreation Facilities

Phil and Jason spent almost two years working with planning staff on their pre-application before submitting a formal application to Jefferson County for the SMBP. During that time, they had ample opportunity to discuss their project with key stakeholders in Conifer and Jefferson County and outline issues the park would help address. It is widely accepted by Jefferson County leadership that public trail infrastructure in the county is insufficient to adequately serve the demands of all the trail

April 17, 2024

Page 5

users wanting to recreate in the outdoors. The recent COVID-19 pandemic certainly exacerbated trail pressure issues in Jefferson County, but these issues existed before COVID-19 and will remain an issue until material progress is made adding trail mileage for recreators in Jefferson County, ideally with trail infrastructure for specific user groups to reduce user conflict and enhance user experiences.

While Phil and Jason's experience with overcrowded trails in Jefferson County began as anecdotal, conversations with County leadership soon confirmed their suspicions. Maybe the most poignant example of this was from their conversations with Jefferson County Open Space. JCOS is currently seeing about seven million visitors annually to their open spaces, with mountain bikers representing a significant percentage of those users. While the land partner for the Bike Park project has always been the Colorado State Land Board, Jefferson County Open Space reached out to our team in the early days of the concept about the possibility of siting the bike park on a parcel of underutilized JCOS property. Ultimately, it was decided that a public / private for-profit arrangement is not compatible with the mission of JCOS, but their interest in the concept's ability to alleviate mountain bike related pressure on their trails is direct evidence of a change in circumstance necessitating the construction of a park like SMBP.

Further evidence of mountain bike-related trail pressure impacting open spaces can be found in Jefferson County's Open Space's recent trail management changes. For example, in September 2020, the County established designated use days at Apex Park on select trails, where only mountain bikers are allowed on even calendar days and no bikes are allowed on odd calendar days. These management considerations were a result of heavy use and user conflict, presenting a need for more facilities with designated use. Additionally, Staunton State Park is in the Conifer Area and is less than one linear mile from the proposed location for the SMBP, is a go-to mountain biking spot for visitors to the area, and has seen a notable increase in visitation in recent years. Between 2016 and 2020, Staunton's monthly visitation has jumped from roughly 15,000 visitors to over 40,000. In 2023, the park saw nearly 300,000 visitors annually and is one of the few parks that is still seeing visitation increases following the COVID-19 pandemic. Lastly, Colorado Parks and Wildlife has also recognized that Colorado State Parks are overwhelmed with visitors, especially at parks closer to Colorado's Front Range, and that over 3000 miles of new trail will need to be built by 2026 to accommodate visitor growth. So, the trail pressure issues we're discussing here are directly impacting the community where we're proposing to site SMBP.

The Colorado Mountain Bike Association's (COMBA's) documented support for our project is also compelling evidence of change in circumstance. Of course, COMBA has a

April 17, 2024

Page 6

mountain biking focus, but beyond that they are heavily focused on trail advocacy for all user groups and contribute significantly to the construction and maintenance of trails across Jefferson County. COMBA has helped develop / maintain miles of trail in Jefferson County since 2020, and is on the record evangelizing SMBP as a needed addition to the arsenal of trail experiences available to Jefferson County residents. As a recognized authority on trail advocacy/strategy and a JCOS partner, COMBA's identification of this need is another change of circumstance in support of this type of use on the Property. Here is an excerpt from their participation in the Outside 285 Study that was done in 2021; we will discuss this planning exercise in more detail later in this narrative: "trails and recreation infrastructure in the Outside 285 region have become discovered, explored, and in time, increasingly overused by an influx of visitors. This has resulted in degradation of trails and infrastructure, crowding at popular destinations, increased conflict between visitors, increased pressure on wildlife due to unplanned trails, and an overall loss of one's ability to find solitude.....these increases are not likely to abate with the end of the pandemic, and may have set a "new normal" for recreation pressure in Colorado. With the Front Range's population projected to increase by 20% by 2030."

We should also be heavily focused on what people local to the Conifer Area are saying about the availability of recreational opportunities in their community, and how those needs are not being met. The Communications Director for SMBP also serves as a board member on the Conifer Area Council, one of the largest community focused organization in the Conifer Area. The CAC frequently takes surveys of Conifer residents to help determine what kinds of assets / resources are lacking in the community. In 2022, the CAC's community survey focused on the availability of services, businesses, transportation, and recreation, and whether existing conditions meet community needs. Respondents generally expressed a desire for additional mountain biking trails and support for a Parks and/or Recreation District.

These responses suggest community interest in additional mountain biking and recreation opportunities in the Conifer Area, and if we need further evidence of local demand, we should look at local mountain bike organizations and their desire for dedicated infrastructure. Some basic examples are the Conifer High School and Conifer Middle School Mountain bike teams, the leaders of which are local to the Conifer Area and are supportive of our project. Community and school-based mountain bike teams are exploding in Colorado's front range and putting a lot of pressure on local trail networks such as the Session Series, a partnership between COMBA and Team Evergreen Cycling. Also, testimony from community leaders supporting the Project can be found on the SMBP website. The bulk of that testimony focuses on the value our park would

April 17, 2024

Page 7

add as a dedicated recreational asset for families and younger generations coming up in Conifer.

It's also important to point out that Jefferson County's Planning Department is on record advocating for additional recreational opportunities in unincorporated Jefferson County. In 2021, the Outside 285 Master Plan was published. This plan was a collaborative, regional planning effort to combine goals on recreation, conservation, and land management in the Highway 285 region. The plan focused on zones within the region, one being the Evergreen/Conifer Zone, in which the proposed parcel for the SMBP lies. Objectives for the Evergreen/Conifer Zone, as outlined in the Outside 285 Master Plan, include enhancing visitor experience, improving capacity, and managing conflict, all of which would be supported by our Project. We understand that the Outside 285 Master Plan is a guiding document and not a decision document, but it is the most recent example of Jefferson County going on the record about its specific goals for unincorporated Jefferson County and the 285 corridor.

Land Management & the Colorado State Land Board

Our team feels it's important to discuss the land partner for SMBP, the Colorado State Land Board (the SLB). Specifically, we would like to discuss how they operate differently than traditional private landowners, and how their recent change in posture toward the parcel of land where the bike park is proposed should be considered a change in circumstance.

The SLB manages a land trust for the State of Colorado. The SLB has a constitutional mandate to leverage their property holdings to generate revenue for K-12 education in our state; as such, they are a revenue focused organization, not a conservation focused organization.

The SLB has owned the parcel where SMBP is being proposed for over 140 years, since their incorporation in 1876. Historically the parcel has remained unused or been leased for agricultural purposes, neither of which has generated material revenue for the SLB to contribute to their education programs. Our team approached the SLB about partnering together on the bike park in 2020, and discovered our outreach was timely because the SLB was evaluating ways this parcel could more substantially contribute to their trust. Our team has partnered with the SLB on the development of the SMBP concept and believe that our project would generate material revenue for the SLB while providing valuable stewardship of land.

April 17, 2024

Page 8

Our team understands that certain community members are used to this parcel being undeveloped, which is why we believe that the SLB's change in posture on this parcel should be considered a change in circumstance. The SLB's history with land in Jefferson County is largely one of parcel disposal and development of land. The SLB used to own over 30,000 acres of land in Jefferson County, and now owns fewer than 3,000. Most of their parcel disposals have been leveraged for a range of different development types. That said, the SLB does have a documented history of allowing their land holdings to be used for recreation. There is a parcel of SLB property that is part of Staunton State Park, which is local to the Conifer Area. Our team views our collaboration with the SLB on SMBP as consistent with SLB land use in the Conifer Area, and a way to head off potential disposal of the property for more disruptive types of development.

Conclusion / Conformance with Jefferson County Master Planning:

While we all know that the sport of mountain biking has deep roots in the state of Colorado, it's important to acknowledge that the SMBP concept is new for our state. There is no independent dedicated lift served bike park in the state of Colorado, as the lift-access bike park market is dominated by traditional Colorado ski resorts that offer a short summer season.

Our experience with Jefferson County's planning staff has been great, and we believe planning staff to be robust, thoughtful, proficient, and forward thinking. That being said, given that the SMBP concept is new for our State, we would not expect there to be specific guidance or recommendations for this type of use in existing planning documents.

While the proposed use is a new use to the area, there are many ways in which it is compatible with the goals and policies of the Jefferson County Comprehensive Master Plan (the "Plan"). As described in detail in the Application Narrative included with our original application package, SMBP will provide additional trail capacity, learning opportunities, public health/active living incentives, job and economic opportunities, and forest health benefits. The proposed use is also consistent with current land uses that deliver significant value to the Conifer Area. As discussed above, there are three JCOS parks and a State Park in the Conifer Area. In total, these recreational assets are likely host to over ½ million annual visitors, a significant percentage of which are mountain bikers. SMBP will be a more mature and professionally managed extension of the recreational experiences that the Conifer Area already knows and loves, while alleviating trail pressure and improving the trail experience for all users.

April 17, 2024

Page 9

In conversations with County planning staff, our team was advised to avoid tying our case for change in circumstances to population growth in the Conifer Area and Jefferson County more broadly. With other types of development that guidance would make a lot of sense, but when it comes to recreational development it seems important to consider the growing number of Jefferson County residents that are demanding places to recreate. Colorado Parks and Wildlife makes this point in “Colorado’s Guide to Planning, Trails with Wildlife in Mind,” where they claim that in other states it is very difficult to link increase in population to increased demand for recreation, but in Colorado, people move to Colorado to recreate, and increased population almost always means increased demand for recreational opportunities outdoors.

SMBP will also be located near the existing recreational assets in the Conifer Area, further reinforcing the park’s consistency with surrounding land uses. In conclusion, we believe that our proposed use of land is supported by changes in circumstance and the growing demand for outdoor recreation in Jefferson County and the Conifer Area.

2. *The proposed access road is approximately 20-25 feet from the property line and there are trails approximately 18 -20 feet from the property line. The nearest home appears to be approximately 20 feet from the property line. Page 3 of the Proposed written restrictions document states that trails will be setback 30 feet from all property lines. Trails should be setback further from the property line to reduce impacts to adjacent neighbors. While setbacks are listed in the A-2 zone district for structures, there are not for setbacks for other amenities such as trails. This should be added to the proposed written restrictions. **We previously recommend meeting or exceeding the setbacks listed in A-2 for structures or developing a Non-disturbance area along the property boundaries that are adjacent to residences/agriculturally zoned properties. The ODP lists setbacks as 50 feet for any structures from all property lines. It also requires any trails to be 50 feet from all property lines. This meets the previous request. However, we would like some clarification on some of the clearing language. There is also a trail clearing width of 20 feet and a chairlift corridor clearing width of 50 feet, is the intent for the 50 foot setback for trails to be taken from the edge of that trail clearing or centerline of the trail/chairlift corridor? The restriction for the chairlift terminal is clear since we would measure setbacks from the chairlift itself.***

Response: We have committed to setbacks of 50 feet for structures on the property. To clarify the clearing language, these setbacks would be from the edge of trail clearing corridors.

April 17, 2024

Page 10

3. ***The cover letter states that during seasonal closures no guests will be permitted, with the exception of guests visiting the Property during a Special Event and that staff may visit and use the property during seasonal closures. This does not seem clear in the written restrictions. It appears that perhaps the definition of Seasonal Closure was left out of the ODP. 12.b. references "Seasonal Closure", but there is no definition. Staff use during permitted and not impact wildlife.***

Response: A definition for "Seasonal Closure" has been added to the ODP for clarification; additionally, there will be no Special Events permitted within the Seasonal Closure.

4. *Thank you for clarifying guests vs. visitors and only using the term guest.*
5. *"Other entertainment" has been removed from the ODP. This addresses our concern about that potential use.*

Response: Comments are noted.

III. Physical Constraints

Slopes

1. *There are several areas of slopes over 30% on the property. The applicant did provide a slope analysis and it appears that structures will be constructed in areas with less than 20% slope.*

Response: Comments are noted.

Floodplains/Wetlands

2. The Physical Constraints section contains additional policies about floodplains. (CMP p. 34) ***There is a floodplain along North Turkey Creek, previously we requested that it be delineated on the Special Use Graphic. The applicant pointed out that this is a Jefferson County floodplain. Jeffco floodplain regulations would apply to this area.***

Response: This has been included in the Special Use Graphic in the ODP. Refer to the ODP to review this change.

3. *Wetlands on the property are shown on the graphic and language in the ODP states that no buildings, parking or chairlift is allowed in this area. Trails or access roads are allowed with certain mitigation techniques. This adequately addresses the Plan policy about protecting and enhancing wetlands (CMP p. 35)*

April 17, 2024

Page 11

Response: Noted.

Wildfire

4. ***This property is within a High Wildfire Hazard Risk area. A Wildfire Risk Assessment was completed by The Ember Alliance with the initial referral and was revised since then. With the revision there is no discussion of evacuation and discussion of the treatment unit appears to be changed to management units and dramatically reduced. What occurred to make these changes to the report?***

Response: In the first referral resubmittal, we submitted a Wildfire Hazard Mitigation Plan in response to comments from the County and referral agencies and after conversations with our Case Manager and agency contacts including those representing the Elk Creek Fire Protection District. The plan was informed by the conversations we had with relevant referral agencies and was intended to override the recommendations of the Wildfire Risk Assessment. We would also like to note that it did not receive further comment from the Elk Creek Fire Protection District or the Colorado State Forest Service in the second referral.

The Wildfire Hazard Mitigation Plan proposes a number of treatments to the landscape to preserve forest health and prevent wildfire risk; additionally, it proposes evacuation in the event of a major wildfire. To safeguard the evacuation area, Management Area H recommends mitigation along Shadow Mountain Drive to reduce flame heights and provide a mitigated corridor for guests to the Property and community members to evacuate. The background information included in the Wildfire Risk Assessment, such as an evaluation of vegetation types, flame heights, and evacuation times, still applies; however, the Wildfire Hazard Mitigation Plan describes recommended mitigation measures to reduce risk of wildfire in the future, which will be carried out by us as indicated in the ODP.

5. ***The written restrictions state that Landscape Plans will integrate the Wildfire Hazard Mitigation Plan recommendations. This will provide a coordinated landscaping and wildfire mitigation.***

Response: Comment noted.

6. ***While the CMP does not have specific policies regarding evacuation, it does contain three policies related to access in the Wildfire section. Those discuss creating shaded fuel breaks and linking existing development to New Development to provide multiple access points. Roadway mitigation is an item addressed in the Wildfire Risk Assessment. This property would not provide any road connections to the developments to the south and west.***

April 17, 2024

Page 12

- 6.a *The applicant discussed a possible connection via the access road to Conifer Mountain Drive. Specific access points would be addressed if the Special Use is approved and a Site Development Plan is required.*

Response: Comment noted.

- 6.b *The revised report contains recommendations for 8 different management areas. A vegetation preservation plan shows the various management areas. However, it does not appear that there is a requirement for the Wildfire Mitigation Plan to be implemented in the ODP.*

Response: Refer to the Use Areas graphic and the “Overlay Areas” section of the Written Restrictions in the ODP. This section states that “mitigation strategies as outlined in the Wildfire Hazard Mitigation Plan will be implemented.”

- 6.c *A revised Wildfire Mitigation Hazard Plan was submitted for this referral. It appears the previous recommendations regarding aspen stands was removed. Management Area A, C, E, F and H talk about excluding aspen from treatment. Management Area G talks about selecting aspen to remain over other species. While the Special Use document states that landscaping plans will integrate Wildfire Hazard Mitigation Plan recommendations, there is not a specific restriction noting that the Wildfire Hazard Mitigation Plan recommendations will be completed.*

Response: Refer to the comment above; the Use Areas graphic and the “Overlay Areas” section of the Written Restrictions in the ODP address the Wildfire Hazard Mitigation Plan recommendations and demonstrate our commitment to implementing these recommendations.

- 6.d *Unit H recommendations are off the property, how can it be ensured that those mitigation techniques will be completed? Are those recommendations solely in County right-of-way or do they extend onto private properties?*

Response: This was briefly discussed with Long Range in a meeting in response to these comments and the following response includes the clarifications discussed: Unit H includes the right-of-way and extends onto adjacent private properties. We cannot commit to mitigation techniques offsite but have discussed this recommendation with our Case Manager and with Jefferson County’s Road & Bridge department, and they are willing to work with us to consider mitigation within the

April 17, 2024

Page 13

ROW. We also believe that mitigation along Shadow Mountain Drive is in the best interests of adjacent private property owners due to its benefits to forest health and the safety of the entire Shadow Mountain community in the event of a fire, and therefore is optimistic that adjacent landowners will be willing to collaborate, particularly because we plan to oversee implementation of the mitigation efforts including with financial assistance.

7. *Basecamp:*

7.a *Clearing as much area around the parking lot as possible, while keeping Aspen stands.*

- ***This should be addressed in the Special Use document. A non-disturbance area could be graphically shown around the Aspen stands and/or a written restriction could note that Aspen stands should be preserved. The Special Use document should contain a section about Landscaping to note that any landscape plans will be consistent with the recommendations of the Wildfire Risk Assessment***

- ***This was not done in the revised special use document.***

Response: Management area G, as identified in the Wildfire Hazard Mitigation Plan, identifies wildfire mitigation strategies around the parking lot area similar to those identified in the Wildfire Risk Assessment; because the Wildfire Hazard Mitigation Plan was prepared in lieu of the Wildfire Risk Assessment recommendations, we identified those areas and deferred to the recommendations within the plan. For Management Area G, the Plan specifically states that “from 30-100 feet from structures, there should be [...] no more than 18 to 24 feet, respectively. If there are aspens, those should be selected to remain over any other species.”

Additionally, the Vegetation Preservation Plan outlines that aspen stands shall be preserved and we have updated text in the ODP to reflect clearer landscaping requirements. Please refer to the updated ODP.

7.b *Prohibit wood fencing.*

- ***Wood fencing is prohibited in the ODP as recommended on page 28 of the Wildfire Risk Assessment.***

April 17, 2024

Page 14

- *Which trees are to be removed would be addressed with the required SDP wildfire mitigation.*

Response: Comments are noted.

8. *South End:*

- *Fencing of aspen to prevent browsing from animals.*
 - ***This was not discussed in the updated Plan.***

Response: We agree that the ODP submitted in the 1st referral response package did not specifically address this measure because the Vegetation Preservation Plan prioritizes preserving existing healthy aspens. This can be done with measures such as fencing and avoiding aspen stands in areas of development. We have updated the ODP to include language on these measures.

9. *There were several recommendations about signage, however, the County cannot dictate the content of signs, so this would need to be addressed by the applicant without County enforcement.*

Response: Comment noted.

10. *Roadway mitigation would be covered by SDP.*

Response: Comment noted.

11. ***The previous Wildfire Risk Assessment suggested a 300-foot buffer around the parking lot. So that this work could be completed on this property, we recommended the parking lot be setback 300 feet from the property lines. It does not appear that this was addressed and that recommendation is now removed from the Wildfire Hazard Mitigation Plan without explanation.***

Response: We have considered this feedback and the implementation of a 300-foot setback for wildfire risk. This setback was recommended in the Wildfire Risk Assessment in order to create a safety zone to shelter in place on the Property in event of a wildfire. As indicated in the Wildfire Hazard Mitigation Plan included with the first referral resubmittal package, mitigation along Shadow Mountain Drive is recommended instead to provide a safe

April 17, 2024

Page 15

evacuation corridor in event of a wildfire. In other words, the plan in the event of a wildfire has changed from creating a safety zone on the property to opting for evacuation. This was due to a number of factors, including the feasibility of creating the safety zone on the property (and the scenic/environmental impacts that would have come with it), the other mitigation measures proposed through the Wildfire Hazard Mitigation Plan, and discussions with both the Elk Creek Fire Protection District (correspondence 8/25/2023) and Road & Bridge (correspondence 9/14/2023) which indicated that both agencies were willing to consider this approach. This recommendation would also provide benefits to other residents in the vicinity who would travel along Shadow Mountain Drive in case of an evacuation event.

12. *Slash mitigation would be covered by the SDP.*

Response: Comment noted.

13. *The Elk Creek Fire Protection District's Community Wildfire Protection Plan (CWPP) should be followed.*

- 13.a *Defensible Space is recommended by the CWPP and is a requirement for any new building permits in the County. Additionally, the applicant has submitted a Wildfire Risk Assessment that contains recommendations as noted above.*

Response: Noted. The Wildfire Hazard Mitigation Plan identifies Management Area G to create defensible space meeting Home Ignition Zone standards as defined by the Colorado State Forest Service.

- 13.b *The CWPP recommends roadway management with maintenance plans. Roadway treatments on this property along Shadow Mountain Drive should be a part of the Wildfire Mitigation work that is completed with the SDP.*

Response: Noted. This mitigation is also included in the Wildfire Hazard Mitigation Plan and referenced by the ODP.

- 13.c *The site will be mitigated as outlined in the Wildfire Risk Assessment at the time of Site Development Plan, this should address the section of the CWPP that discusses Stand-level fuel treatments. (p. 52)*

Response: Noted; however, we would like to clarify that the site will be mitigated as outlined in the Wildfire Hazard Mitigation Plan and not the Wildfire Risk Assessment, as the Plan has replaced the guidance in the Assessment.

April 17, 2024

Page 16

13.d *This area is within the Conifer Mountain plan unit. It is designated at an extreme relative risk. Measures will need to be taken to reduce that risk. Primary mitigation suggestions include Defensible Space, Create linked defensible space, landscape fuel treatments, home hardening and roadside mitigation. (p. 67) All of these mitigation suggestions can be addressed if the Special Use is approved and the project moves to the SDP process.*

Response: Noted. Additionally, defensible space, landscape fuel treatments, and roadside mitigation are addressed in the management areas identified in the Wildfire Hazard Mitigation Plan.

Wildlife

14. *The majority of the property is within a high wildlife quality habitat area, with portions of the property along the creek being maximum quality habitat areas, due to riparian habitat and wetlands. The Plan recommends avoiding maximum quality habitat areas and reducing impacts to high quality habitat areas.*

The applicant submitted a Wildlife Report. It noted that Elk use the property year-round and that constant use of the bike park would decrease the value to elk and other wildlife.

The Colorado Division of Parks and Wildlife has submitted comments on this proposal and note that the area is used by elk, deer and increasingly by moose. It is also used by mountain lions, bobcats, foxes and coyotes year round. They note that this parcel has important wildlife value and plays an important role in maintaining connectivity of wildlife habitat in an area that is becoming increasingly fragmented by a combination of infrastructure, traffic and growing recreational use.

Response: Comments noted.

15. *The revised ODP contains additional restrictions to address wildlife concerns. Those additions include:*

- *Designation of a Wetlands Overlay with restrictions. These restrictions limit activities in this area to trail or access road crossings. Those crossings are required to mitigate impacts through bridges, raised platforms, or similar design techniques.*
- *Limitation on lighting that there is no exterior lighting in the Wetlands Overlay or in Use Area B.*
- *Restriction that lighting is directed away from the Wetlands Overlay.*

April 17, 2024

Page 17

- *Allowing only wildlife friendly fencing on the property.*
- *Requiring wildlife-proof trash, recycling and composting containers.*
- *The creation of a seasonal closure from January 1 to April 1.*
- ***As noted above, it appears that a definition of Seasonal Closure was supposed to be included, but was not. We do have concerns about special events impacting wildlife during those seasonal closures.***

Response: We have revised the ODP to include a definition of Seasonal Closure. Additionally, as stated in the Second Referral Response – CPW – SMBP letter, we are committed to working with Colorado Parks and Wildlife if the concept is to be approved to understand mitigation measures and whether or not special events would be appropriate during the Seasonal Closure.

- 15.b *These additions address the majority of comments/suggestions related to wildlife in the previous comments. While perimeter fencing is not limited, all fencing is limited to wildlife-friendly fencing, which does mitigate impacts.*

Response: Comment noted.

IV. Community Resources

Historic Resources

1. *There are no historic resources identified on this property in the Historic Resources map.*

Response: Comment noted.

Visual Resources

2. *Portions of this property, mainly in the southwest corner are highly visibility from the 285 Viewshed map and the County Hwy 73 Viewshed map.*

Response: Noted.

3. *Additionally, the community identified the meadow along Shadow Mountain Drive as a visual resource.*

April 17, 2024

Page 18

- *An updated Visual Analysis was provided. This shows the lodge and the lifts and seems to better show the clear area for the lift line and access road. The narrative also talks about how trails, and treatments and clearing for Wildfire Mitigation are depicted in the simulations.*

Response: Noted. We would also like to emphasize that our project would only impact less than 10 percent of the meadow area along Shadow Mountain Drive; the remainder of this meadow area will be left undisturbed or is on an adjacent property and privately owned.

Open Space and Trails

4. *The Conifer/285 Corridor Area Plan contains a section regarding Trails Development (p. 21-Conifer) Policies state:*

4.a *Trails should provide a link throughout the Plan area. Trail design should create trails that:*

i. *Vary in length, gradient and the nature experience;*

- *This proposal would provide a different trail experience than in any other location of the County. It would also provide for beginner through advanced mountain biking terrain.*

Response: Comment noted.

ii. *Link the community, provide wildlife corridors and serve as potential greenbelts;*

- *A Wetlands Overlay has been added to the ODP. Within this area, no permanent building, parking nor chairlift is permitted. These restrictions will help to maintain a wildlife corridor along the wetlands along Shadow Mountain Drive. Previously, there was a parking lot proposed over some of the wetlands, this has been removed and restrictions would not allow that to occur. Additionally, while trail or access road(s) are allowed in this Overlay, the impacts will need to be mitigated with specified design techniques.*

April 17, 2024

Page 19

Response: Noted; we understand that specific mitigation will come during site design.

iii. *Provide access for those with special needs and necessary conveyances, where appropriate;*

- *The chairlift will provide access to the mountain biking for those with special needs.*

Response: Comment noted.

iv. *Traverse diverse landscapes;*

- *The landscapes on this property are relatively uniform, but there are different experiences at the north end vs the south end of the site. The paths on the property will provide access to the entire site.*
- *The applicant addressed the previous question about how the applicant will ensure that bicyclists will not create their own paths in the sensitive wetland areas.*

Response: Comment noted.

v. *Provide turnouts and access to scenic views and vistas;*

- *The applicant addressed the previous question about areas to take advantage of views and vistas.*

Response: Noted.

vi. *Intersect to allow a choice of routes from a point of origination to various destinations; and*

- *There will be a variety of options from the top of the chairlift and there are choices on some of the proposed trails to take a different route. However, most trails are separated to avoid interactions between beginner and more advanced cyclists.*

Response: Comment noted.

April 17, 2024

Page 20

4.b *Avoid areas containing threatened, endangered, sensitive species, or fragile environments.*

- *There are no threatened or endangered species identified as existing or having potential habitat on this site. The Wetlands Overlay restricts development in the wetland area along North Turkey Creek.*

Response: Noted.

4.c *Restrict motorized activities to designated areas*

- *The ODP contains restrictions that prohibit motorized use on trails, it does still allow e-bikes, which is a good provision. This addresses the previous concern about motorized activities throughout the site, such as a motocross track.*

Response: Noted.

Air, Light, Odor and Noise

5. *The Community Resources section contains policies related to Air, Light, Odor and Noise and Recreation and Tourism that should be addressed.*

Plan policies discuss minimizing light impacts to protect the night sky, avoid pollution, and avoid light or Glare trespass on adjacent properties and Wildlife Habitat. (CMP p. 43)

Response: Noted.

6. *Previously, there were concerns about lighting of the wetland area, which is maximum quality wildlife habitat. Restrictions now state that lighting will be directed away from the Wetlands Overlay.*

Response: Noted.

7. The Area Plan discourages internally illuminated signs. (Conifer p. 15)

- *The written restrictions state that signs will not be illuminated.*

Response: Comment noted, refer to Signage restrictions in the ODP.

April 17, 2024

Page 21

8. Businesses are encouraged to turn off all non-essential lighting after business hours, leaving only the necessary lighting for site security. (Conifer p. 15)
 - o *Again, lighting restrictions have been modified as noted above to minimize lighting impacts.*

Response: Noted, refer to Lighting restrictions in ODP.

9. *The Noise policies in the Comprehensive Master Plan discuss the potential noise impacts from hours of operation, mitigating the use of outdoor speakers, amplified music, and/or paging systems where residential uses could be impacted, minimizing noise to maximum/critical wildlife Habitat areas, ensuring noise is reviewed and, if necessary, mitigated and mitigating noise that is annoying, but does not exceed State noise standards. (CMP p. 44)*

Response: Comment noted.

10. *Previously, there were concerns with allowing noise levels for Light Industrial uses and potential noise from the chairlift. The noise standards have been modified to only allow noise levels for residential uses, which is compatible with the surrounding uses.*

Response: Noted

11. ***A Sensory Impact Study was included which analyzed noise. However, it is unclear how the LDR Noise Criteria, which discusses L25, L0, and periodic/impulsive standards relates to the table with LAeq noise levels shown in Table 8.1 and 8.2. There was some discussion in the report about these various standards, but Staff may need to have a meeting with the consultant that prepared the Sensory Impact Assessment to further understand the various ways to measure noise and whether the LDR standards are met.***

Response: We organized a meeting between Heather Gutherless and Sam Arnold of Stantec, the consultant who prepared the Sensory Impact Assessment for the application. The discussion clarified the noise standards and how they apply. Additionally, Stantec updated the noise study so that it could be more easily interpreted with the County noise standards; the updated Sensory Impact Assessment is included in this resubmittal package.

12. *As recommended by the Plan, hours of operation have been set. Those are sunrise to sunset, which seems appropriate given the type of use and that this is the restriction on Jefferson County Open Space parks.*

April 17, 2024

Page 22

Response: Comment noted.

13. *The Sensory Impact Study states that there will be speakers near the day lodge outside dining area. Will those speakers just be used for general announcements, like tee times at a golf course, or will music be played continuously throughout the day? What is the purpose of those speakers and are there other ways to convey the same information?*

Response: The speakers would be used for announcements only and not music, except for Special Event Permit uses. This has been analyzed in the Sensory Impact Assessment and has been included as a restriction in the ODP.

14. Noise will be mitigated to the wetlands/floodplain through restricting noise allowed to residential standards.

Response: Comment Noted.

15. *The Conifer/285 Corridor Area Plan have additional noise policies related to minimizing noise, considering high noise levels incompatible unless mitigation can decrease the number of noise sources or how the noise is heard, and implementing hours of operation. (Conifer p. 15)*

- *Sound levels shall adhere to the maximum permissible noise levels for residential uses.*

V. Infrastructure, Water, & Services

Transportation

1. *The Comprehensive Master Plan discusses ensuring new development has adequate transportation infrastructure to serve it and mitigating negative impacts. Also, how transportation infrastructure and parking areas should balance safety, neighborhood character, and environmental impacts. (CMP p. 48)*

Response: Comment noted.

2. *Additional policies in the Conifer/285 Corridor Area Plan discuss limiting roads to 2 through lanes with appropriate turning, acceleration and deceleration lanes and limiting improvements when they are expensive and would degrade the physical environment. (Conifer p. 29-30)*

Response: Comment noted.

April 17, 2024

Page 23

3. ***The County's engineers had several comments on the Transportation Analysis provided with this application. Those comments should be addressed in the 3rd submittal.***

Response: Comment noted; an updated Transportation Analysis is included in this resubmittal package.

4. *There is no proposed Bicycle infrastructure shown in the Bicycle Plan.*

Response: Comment noted.

Water and Wastewater

1. *Comprehensive Master Plan policies discuss demonstrating water is adequate and available for the uses proposed, how new development should provide adequate water for firefighting services and how new development served by a well should also be served by a treatment system or facility in the same general area as withdrawal. A key provision in this section discusses how development should be at a scale density consistent with Locally Available Water Resources. Locally Available Water Resources are the surface and ground water that is physically in the watershed sub-basin where the development is occurring, not including water brought in from outside sources such as truck, pipeline, or other means. (CMP p. 49)*

Response: Information noted.

2. *The applicant provided Water supply cover letter and an engineering study for the water system improvements. The cover letter states that the water will be obtained in two phases. First, an exempt commercial well permit of 0.33 acre-ft per year would be requested. At the same time, the applicant will start the process for a water augmentation plan to supply the facility with 2 acre-ft per year for full build out of the facility. Water will be used for both the facility and for fire sprinkler water. Since water would be coming from a well, it would be from a Locally Available Water Resource.*

Response: Information noted.

3. *The proposal is situated in the North Turkey Creek Basin of Jefferson County. The letter from the Division of Water Resources states that "the ability for the applicant to obtain well permit(s) and the allowed use(s) will be determined at the time the permit applications are submitted to and reviewed by the State Engineer's Office". With the Pre-application, we had asked if there were water rights available in this basin. It sounds like that would be determined once an application was submitted and reviewed.*

April 17, 2024

Page 24

Response: Noted; it is our understanding that water rights would be determined at the SDP phase.

4. *The cover letter discusses that a water storage tank will be constructed to provide for sprinkling of the lodge building. Water for this storage tank would not need to come from the well, but could be hauled in since it would not be used for the water consumed by the lodge.*

Response: Correct; these upgrades are included in the Engineering Study for Water System Improvements included in this resubmittal package.

5. *The CMP also discusses how in areas served by an individual or community well, emphasize low water demand uses. (CMP p. 49) This proposal is estimated to use 1,400 gallons per day on approximately 235 acres. Appendix C contains a table of Land Uses with Water Estimates. If this property were built out under the existing A-2 zoning, which has a 10 acre minimum lot size, it could potentially allow for up to 23 residences. According to the Land Uses with Water Estimates table, a single-family detached unit is estimated to use 300 gallons of water per day. That would mean that there could be a total water demand of 6,900 gallons of water per day if built out to the maximum under existing zoning.*

Response: Noted. As described in the Application Narrative included in the initial application submittal, if the Property were developed for residential uses, it would require significantly more water use than the Project.

6. *Sanitation will be provided by an onsite septic system. Where a property is served by well water, the Plan recommends an onsite wastewater treatment facility be used as well to facilitate water recharge. The comments from Jefferson County Public Health estimate that the proposed development would generate 1800 gallons of wastewater per day. That would make the application eligible for an OWTS permit through the County. If the average daily flow is 2,000 gallons per day or more, then a Site Approval process with the Colorado Department of Health and Environment (CDPHE) would be required.*

Response: Information noted.

Utilities and Services

7. The plan recommends locating utility lines underground, where practicable. (CMP p. 51) The power line along Shadow Mountain Drive is proposed to be buried, which would

April 17, 2024

Page 25

comply with the policies in the Plan and would reduce wildfire risk. Another power line would be utilized from the western boundary and would be an overhead line. *The applicant has noted that this line is an existing above-ground power line that would be tapped into. Since there would be no new power lines located in this area, it is acceptable to not bury that power line. There may be more needed at the time of SDP since burying of powerlines is in the LDR, but for the rezoning, this is acceptable. We will still want to ensure at the time of SDP that vegetation is cleared within 10 feet of any existing power poles.*

Response: Noted, we are willing to continue this planning during the SDP.

8. Elk Creek Fire Protection District had many comments on how the site should be designed and constructed. While many of these would not be reviewed until the time of Site Development Plan, it is good to know what those requirements would be. Additionally, there are some items that should be considered at the time of Special Use.

- 8.a ***The Fire district talked about how an approved fire protection water supply capable of supplying the required fire flow for fire protection would be required. Would this require the installation of a cistern? If so, where would that be located and how would it impact the Special Use graphic?***

Response: The additional fire flow would require 180,000 gallons of storage. This would require an additional storage container, which could either be a cistern with a fire pump or an above-ground water tank. Refer to the Engineering Study for Water System Improvements included in this resubmittal package for an updated plan of a water supply system that meets this need.

- 8.b ***The fire flow report will be submitted with the SDP.***

Response: This is our understanding as well.

VI. **Design Guidelines**

The Conifer/285 Corridor Area Plan contains many Design Guidelines on pages 33-48. Applicable policies are noted below.

April 17, 2024

Page 26

Vistas, View Corridors & Scenic Areas

1. *Preserve view corridors for existing or future adjacent development.*

- *The visual analysis was updated with additional locations based on case manager review.*

Response: Correct.

2. *In transition areas between lower and higher density uses, ensure that more intense uses are not visually obtrusive to adjacent lower density uses.*

- *Setbacks will be similar to or larger than the surrounding A-2 setbacks.*

Response: Correct.

3. *Prevent silhouette of structures on ridgelines.*

- *The updated visual analysis confirms that the top of the lift will not be right on the top of the ridge and will not appear to break the ridgeline.*

Response: Noted.

4. *Avoid outdoor lighting within view corridors or on prominent ridges.*

- *Lighting restrictions have been modified as noted above to minimize lighting impacts. With no lighting permitted in Use Area B, there will not be lighting on prominent ridges. In Use Area A, which would be in a view corridor for Shadow Mountain Drive, lighting will be allowed, but restricted to an acceptable amount.*

Response: Noted.

Parking

5. *Screen or obscure views of parking lots from adjacent public areas or unrelated land uses and on-site users.*

- *The County's landscaping standards will require a certain amount of landscaping around the parking lot areas and within the parking lot itself.*

April 17, 2024

Page 27

Response: Noted.

- *The applicant has proposed modifications to the Landscaping standards that mainly have to do with preservation of existing trees and replacement of trees. We understand that in this situation it would not be prudent to replace every tree removed with 3 new trees, that would just exacerbate the wildfire hazard. However, the language just generally says that any tree which cannot be protected or preserved is not required to be replaced. We suggest saying that to recommended removal through the implementation of the Wildfire Hazard Mitigation Plan is not required to be replaced. There should be language referencing that trees removed shall be in compliance with the implementation of the Wildfire Hazard Mitigation Plan. As the language stands all trees could be removed and no replacement trees added. While it seems like this would be detrimental to the mountain biking experience anticipated by the applicant, we do have concerns that all trees could be cut and none replaced by this development.*

Response: Our case manager also requested a change to the Landscaping restrictions in the ODP; we have incorporated landscaping restrictions that addresses the Wildfire Hazard Mitigation Plan and comments from the County. Refer to the updated ODP included in this resubmittal package.

6. *Minimize parking areas (impervious surfaces) and their expansiveness.*

- *Two different areas of parking have been created with a landscape separation in the conceptual site plan. See previous question regarding parking lot landscaping.*

Response: Noted; please see response above.

7. *Orient building to site amenities. Separate parking from these areas.*

- *The building and site amenities are adjacent to each other with the parking being between the amenities and Shadow Mountain Drive.*

Response: Comment noted.

Signs

April 17, 2024

Page 28

8. *Minimize the size and number of signs to avoid visually confusing roadway entrances or streetscapes. It goes on to state minimums of one sign per project per major road frontage and one sign per building, which lists all tenants.*

- *Signs have been limited to one sign per building, with the exception of window signs, temporary banners and flags. Window signs, temporary banner signs and flags are not required to get a permit, so as long as they meet the Zoning Resolution requirements, this language is acceptable.*

Response: Please refer to the signage restrictions in the ODP.

9. *Integrate signs into overall landscape and building design, carrying out a consistent graphic theme.*

- *The applicant requested suggestions, we suggest adding language about how the signs should match the architectural elements of the primary building.*

Response: Note has been incorporated in the updated ODP.

10. *Minimize negative visual impact of signs on adjacent areas. This guidelines goes on to states that signs should be no closer than 50 feet from adjacent neighbors, to limit signs to one per building and to limit size of a project sign to 64 square feet.*

- ***Signs have been limited to no closer than 50 feet from all property lines, except for Entry Feature signs, which are permitted adjacent to Shadow Mountain Drive. It should be specified how far from Shadow Mountain Drive signs can be placed. 10 feet is the Zoning Resolution standard for Agricultural signs.***

Response: Signage language in the ODP has been updated (i.e., some language removed) so that all signs shall comply with Zoning Resolution standards for Agricultural signs (10-foot setback).

- *Signs have been limited to one per building.*
- *Signs have been limited to 64 square feet.*

Response: Comments have been noted.

Fencing and Screening

April 17, 2024

Page 29

11. *The ODP contains fencing standards that only wildlife-friendly fencing is permitted and that wood fencing is prohibited.*

Response: Noted.

Entrances

12. *Limit the number of entrances to commercial developments.*

- *It is our understanding that only one entrance is proposed.*

Response: This is correct.

Air, Odor, Light and Noise

13. *Integrate light design into overall project design and architecture.*

- ***The location and hours of lighting is addressed, but the design is not.***

Response: We have requested lighting design examples from the County and has incorporated some of this language into the ODP.

14. *Minimize visual intrusiveness of lighting.*

- *Light restrictions have been modified as noted above to minimize lighting impacts.*

Response: Noted.

15. *Minimize light falling on areas not used for activity. Areas not in use or after hours should be lighted only for essential safety requirements.*

- *See comment above.*

16. *Minimize the impact of people-generated noise or more quiet residential and recreation areas to a level that does not exceed normal noise levels of those adjacent uses. It goes on to recommend a minimum distance of 100' between a project's active recreation areas and existing of-site residential structures*

- *Setbacks of the lift, as well as trails and maintenance roads, have been specified. Those setbacks meet A-2 requirements as requested.*

April 17, 2024

Page 30

Response: Noted.

17. *Protect or preserve areas valued for the absence of man-made noise.*

- ***A sensory impact study has been completed to address noise. We have questions about that study.***

Response: The Sensory Impact Study has been updated based on your questions and follow-up conversations and is included with this resubmittal package.

Wildlife & Vegetation

18. *Prevent habitat deterioration where critical wildlife areas exist. Enhance available habitat.*

19. *Maintain the natural wildlife “carrying capacity” of sites that have moderate or high wildlife significance. Improve the carrying capacity of some sites to offset the loss of habitat in developed areas.*

- *Additional restrictions have been added to protect the wetlands and stream corridor.*

Response: Information noted.

20. *Maintain natural vegetation ecosystems adjacent to and within bodies of water, streams, other watercourses, and within associated wetlands.*

- *Additional restrictions have been added to protect the wetlands and stream corridor.*

Response: Noted.

21. *Maintain wildlife movement corridors of a size and character that ensure their continued use.*

- *Additional restrictions have been added to protect the wetlands and stream corridor.*

Response: Noted.

Open Space and Recreation

22. *Prevent damage to vegetation along major roadways.*

April 17, 2024

Page 31

- *Additional protection of the wetlands and stream corridor along Shadow Mountain Drive have been provided in the written sections.*

Response: This is correct.

23. *Avoid using exotic plant species unless: They blend with the intended character of the overall design; no native species can be used as a substitute; they are for special effect or focus.*

Response: Comment noted.

Circulation

24. *Minimize visual scarring of road cuts, or disruption of scenic areas (e.g., meadows).*

- *The visual analysis has been updated to capture the impacts of the trails and maintenance road.*

Response: Comment noted.

25. *Preserve or create a rural image, even in more intensely developed areas*

Response: Noted. Please refer to the Narrative included with the initial application submittal for a discussion of the project's compatibility with the character of the surrounding areas.

26. *Design pedestrian/bikeways and roadways that create attractive, pleasant and safe features for users of the facilities and residents of adjacent property.*

- *This facility would create an off-road facility for bicyclists.*

Response: Comment noted. As described in the Application Narrative, the Project would provide a superior riding experience for interested community members, facilitate rider development for those who are new to the sport, and support the local economy in the Conifer area.

Privacy

27. *Maximize privacy, including visual and auditory, between new developments and existing residential areas.*

April 17, 2024

Page 32

Response: Noted. Please refer to the Sensory Impact Assessment and the Visual Analysis for a summary of anticipated visual and auditory impacts of the Project.

28. *Maintain and enhance property values.*

- *Setbacks will be similar to or more than A-2 setbacks.*

Response: Please refer to the Written Restrictions included in this resubmittal package.

Architectural Design Guidelines

29. *Orient, design, and construct structures that are people oriented and facilitate interaction.*

Response: Noted. The project includes structures such as a chairlift and a day lodge that will provide opportunities for recreation, education, and events, which will support and facilitate interactions among guests at SMBP, employees at SMBP, and other community members.

30. *Buildings should be small and clustered, scaled to respect topography, views and vegetation*

Response: Noted. The development proposes two buildings on the Property and their placement considered topography, views, and vegetation. Specifically, the Maintenance Building would be primarily shielded by vegetation from Shadow Mountain Drive, and both buildings are located in areas that have naturally flatter topography than elsewhere within the Property.

31. *Balance the proportional relationship of the form of building to size of the lot/parcel.*

Response: Noted. The Property is recommended for Residential use, which would accommodate up to 25 homes on the 306-acre parcel. In comparison, this Project proposes two buildings. The proportion of building square-footage to size of the lot/parcel would be less than one percent.

32. *Structures should avoid overpowering the site and be sensitive to the natural landscape's variety and diversity.*

Response: Noted. Please refer to the Visual Analysis for a description of the visual impacts of proposed structures and ODP Written Restrictions regarding maximum building square footage.

April 17, 2024

Page 33

33. *Use the massive elements of the building to express depth, substance, and strength, rather than only surface veneer, i.e., exposed timber, structural beams, solid rock, walls, etc.*

Response: Noted. This design consideration has already been considered and will be incorporated in the SDP and final design process.

34. *Create interesting, diverse, stimulating streets and walls that create varied experiences for people and respond to the landscape in an informal and organic way*

Response: Noted. This design consideration has already been considered and will be incorporated in the SDP and final design process.

35. *Use sculptures, fountains/water features, wood carvings, awnings and canopies, balconies, patios and terraces, flags and banners, umbrellas, the annual colors of flowers and trees (i.e., Aspen), accent lighting, painted wall graphics, etc., in detailing projects.*

Response: Noted. This design consideration will be incorporated in the SDP and final design process.

36. *Create pedestrian amenities that complement surrounding site conditions.*

Response: Noted. This design consideration will be incorporated in the SDP and final design process.

37. *Minimize negative visual impact of exposed foundations.*

37.a *Several of these items could be added into the special use document, others will be addressed by existing regulations if this special use is approved and the project moves forward to the Site Development Plan process.*

Response: Noted. Please see ODP Written Restrictions included in this resubmittal package.

37.b *A Class III recreation facility does not have a size limit. A maximum size should be added to the special use document.*

Response: Noted. Please see ODP Written Restrictions included in this resubmittal package regarding maximum building square footage and areas with development restrictions.

April 17, 2024

Page 34

Sincerely,

A handwritten signature in black ink, appearing to read "Phil Bouchard". The signature is fluid and cursive, with the first name being more prominent.

Phil Bouchard
Shadow Mountain Bike Park

A handwritten signature in black ink, appearing to read "Jason Evans". The signature is cursive and somewhat stylized, with the first name being more prominent.

Jason Evans
Shadow Mountain Bike Park

1889 York Street
Denver, CO 80206
(303) 333-1105
FAX (303) 333-1107
E-mail: lsc@lscdenver.com



April 3, 2024

Mr. Travis Beck
SE Group
tbeck@segrou.com

Re: Shadow Mountain
Bike Park
Jefferson County, CO
LSC #220850

Dear Mr. Beck:

In response to your request, LSC Transportation Consultants, Inc. has prepared this updated traffic impact analysis for the proposed Shadow Mountain Bike Park development to address County comments. As shown on Figure 1, the site is located south of Shadow Mountain Drive about two miles west of County Highway 73 in Jefferson County, Colorado.

REPORT CONTENTS

The report contains the following: the existing roadway and traffic conditions in the vicinity of the site including the lane geometries, traffic controls, posted speed limits, etc.; the existing weekday, Saturday, and Sunday peak-hour traffic volumes; the existing daily traffic volumes in the area; the typical weekday, Saturday, and Sunday site-generated traffic volume projections; the assignment of the projected traffic volumes to the area roadways; the projected long-term background and resulting total traffic volumes on the area roadways; the site's projected traffic impacts; and any recommended roadway improvements to mitigate the site's traffic impacts or the impacts from growth in background traffic.

LAND USE AND ACCESS

The site is proposed to include a downhill mountain bike park with lift service. The site is proposed to have about 300 parking spaces and with about 20 employees. Full movement access is proposed from Shadow Mountain Drive as shown in the conceptual site plan in Figure 2.

The applicant plans to implement ticketing and parking technology to avoid guests arriving with nowhere to park to help reduce impacts to the surrounding area. This process is described as follows:

Parking Reservations

The applicant (SMBP) will implement a parking reservation system that will be available at the time that visitors purchase bike park passes. SMBP will strongly encourage visitors to purchase tickets online prior to arrival, with the goal of making sure visitors do not arrive at the bike

park without a parking reservation. SMBP has decided to implement this system to benefit the visitor experience and surrounding community in the following ways:

1. The parking reservation system will control the amount of riders the bike park sees on any given day, thereby limiting pressure on SMBP's trail network and ensuring the bike park is never over visitor capacity. Limiting visitor capacity will also limit pressure on local roadways, thereby benefitting the surrounding neighborhood as well. The reservation system will allow visitors to relinquish their parking spot when they're done riding so that the parking reservation system stays up-to-date for incoming visitors.
2. The parking reservation system has the ability to reduce the potential for roadway congestion around morning and evening peak-hours because visitors will have a reservation and will have no incentive to rush to SMBP to find parking during opening hours or other peak times.
3. SMBP's parking reservation system will allow staff to closely manage the activity of bike park visitors, which will allow staff to quickly remedy any issues that arise between visitors and residential traffic using the roadways near SMBP.

Cell Phone Service

The base area, in its existing condition, has cell coverage. The rest of the project area has limited coverage. SMBP plans to provide Wifi from the day lodge and work with major providers to improve cell service in the project area for riders.

ROADWAY AND TRAFFIC CONDITIONS

Area Roadways

The major roadways in the site's vicinity are shown on Figure 1 and are described below.

- **County Highway 73** is a north-south, two-lane major collector roadway east of the site. The intersection with Shadow Mountain Drive is stop-sign controlled. The posted speed limit in the vicinity of the site is 40 mph.
- **Shadow Mountain Drive** is an east-west, two-lane collector roadway north of the site. The intersection with County Highway 73 is stop-sign controlled. The posted speed limit in the vicinity of the site is 40 mph but reduces to 30 mph to the east closer to County Highway 73.
- **Barkley Road** is an east-west, two-lane major collector roadway east of the site. The intersection with County Highway 73 is stop-sign controlled. The posted speed limit in the vicinity of the site is 30 mph.

Existing Traffic Conditions

Figure 3a shows the existing lane geometries, traffic controls, and traffic volumes in the site's vicinity on a typical weekday afternoon peak-hour and the daily traffic volumes for five consecutive days. Figures 3b and 3c show the typical peak-hour and daily traffic volumes on a

Saturday and Sunday, respectively. The peak-hour traffic volumes and daily traffic counts are from the attached traffic counts conducted by Counter Measures in August, 2022.

2025 and 2043 Background Traffic

Figure 4a shows the estimated 2025 weekday background traffic which assumes an annual growth rate of one-half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road to maintain a conservative analysis. DRCOG (Denver Regional Council of Governments) shows minimal growth is expected on Shadow Mountain Drive over time. Figure 4b shows the estimated 2025 Saturday background traffic which assumes an annual growth rate of one-half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road to maintain a conservative analysis. Figure 4c shows the estimated 2025 Sunday background traffic which assumes an annual growth rate of one percent. The Sunday daily volumes are based on multiplying the Sunday peak-hour rates by the ratio of Saturday peak-hour trips to Saturday daily trips.

Figure 5a shows the estimated 2043 weekday background traffic; Figure 5b shows the estimated 2043 Saturday background traffic; and Figure 5c shows the estimated 2043 Sunday background traffic. These 2043 background volumes assume an annual growth rate of one percent.

Existing, 2025, and 2043 Background Levels of Service

Level of service (LOS) is a quantitative measure of the level of congestion or delay at an intersection. Level of service is indicated on a scale from "A" to "F." LOS A is indicative of little congestion or delay and LOS F is indicative of a high level of congestion or delay. Attached are specific level of service definitions for unsignalized intersections.

The intersections in Figures 3a through 5c were analyzed as appropriate to determine the existing, 2025 background, and 2043 background levels of service using Synchro. Table 1a shows the existing and 2025 level of service analysis results and Table 1b shows the 2043 level of service results. The level of service reports are attached.

- 1. Shadow Mountain Drive/County Highway 73:** All movements at this unsignalized intersection currently operate at LOS "D" or better during all five scenarios and are expected to do so through 2025. By 2043, the intersection is planned to be converted to a modern roundabout and is expected to operate at an overall LOS "A" during all scenarios.
- 2. County Highway 73/Barkley Road:** All movements at this unsignalized intersection currently operate at LOS "D" or better during all five scenarios with the following exception: The southwestbound to southeastbound left-turn movement operates at LOS "F" during the weekday afternoon peak-hour and the Saturday mid-day peak-hour. By 2025, the southwestbound left-turn movement is expected to operate at LOS "E" or "F" during the weekday afternoon peak-hour, and the Saturday morning and mid-day peak-hour. By 2043, the intersection is planned to be converted to a modern roundabout and is expected to operate at an overall LOS "A" during all scenarios.
- 3. Shadow Mountain Drive/Site Access:** This unsignalized intersection was analyzed only in the total traffic scenarios.

TRIP GENERATION

Table 2 shows the estimated trip generation for the proposed site per the rates developed by LSC based on coordination with the applicant and project team.

The site is projected to generate about 520 vehicle-trips on the average weekday, with about half entering and half exiting during a 24-hour period. During the morning peak-hour, which generally occurs for one hour between 6:30 and 8:30 a.m., about 115 vehicles would enter and about 11 vehicles would exit the site. During the afternoon peak-hour, which generally occurs for one hour between 4:00 and 6:00 p.m., about 8 vehicles would enter and about 80 vehicles would exit.

On the average Saturday and Sunday, the site is projected to generate up to about 1,000 vehicle-trips with about half entering and half exiting during a 24-hour period. During the morning peak-hour, which generally occurs for one hour between 8:30 and 10:30 a.m., about 220 vehicles would enter and about 21 vehicles would exit the site. During the mid-day peak-hour, which generally occurs for one hour between 12:00 and 2:00 p.m., about 15 vehicles would enter and about 155 vehicles would exit.

The average daily traffic during the peak season is expected to be between 520 and 1,000 trips; most weekdays are expected to have 520 or fewer trips.

Details on Vehicle Turnover

This report assumes a vehicle/parking stall turnover estimate of 1.6 (i.e., a parking stall will have 1.6 vehicles parked each day). This estimate is based on a number of factors, including trail mileage, vertical relief, chairlift length, lap time, number of laps/visit, vehicular travel distance to bike park, ticket type (day pass vs. season pass), and length of stay. Specifically, based on these factors, it is estimated that an average lap would be approximately 30 minutes, the average number of laps would be 8 laps, and the amount of milling time (i.e., parking, ticketing, break time/lunch) would be approximately 1 hour. With this information, the average guest would stay approximately 5 hours. For an average operating time of 8 hours, the average vehicle turnover would be the average operating time divided by the average guest stay. This results in an average turnover of 1.6, meaning that on days with a full parking lot, about 60 percent of the spaces could be vacated and then replaced by another vehicle.

The average vehicle turnover is a planning metric used to inform traffic and parking estimates. In this study, it directly informs the average number of vehicles entering and exiting the parking lot and thus the average vehicle trips per day, however, has a less direct correlation with peak traffic patterns because it applies to the full day of operation. Because of the uniqueness of the operation and the variety of planning factors considered to determine the vehicular turnover, there is not an “industry-standard” planning metric.

Details on Visitation

The traffic study assumes 300 parking spaces with a 1.6 turnover ratio per day for a total of 480 guest vehicles per day. Each vehicle enters and exits the site once for a total of 960 daily trips. An additional 40 trips (20 vehicles) were added for employee trips to arrive at 1,000 daily

trips. A vehicle occupancy of 2.5 people per vehicle in 480 vehicles would result in 1,200 guests. There are also 20 employees for a total of 1,220 unique people per day. Our parking turnover assumptions mean these 1,220 people can't all be on the site at the same time. The most people on the site at any given time would be 300 vehicles x 2.5 people/vehicle for 750 guests plus 20 employees for a total of 770 people.

These assumptions are dependent on the assumed 2.5 vehicle occupancy which could vary slightly from day to day. As described above, the Applicant will implement a reservation system to carefully monitor the number of vehicles and guests visiting the site so as to not exceed stated maximums.

TRIP DISTRIBUTION

Figure 6 shows the estimated directional distribution of the site-generated traffic volumes on the area roadways. The estimates were based on the location of the site with respect to the regional population, employment, and activity centers; and the site's proposed land use.

TRIP ASSIGNMENT

Figure 7a shows the estimated weekday site-generated traffic volumes based on the weekday trip generation estimate (from Table 2) and the directional distribution in Figure 6.

Figure 7b shows the estimated Saturday/Sunday site-generated traffic volumes based on the Saturday/Sunday trip generation estimate (from Table 2) and the directional distribution in Figure 6.

2025 AND 2043 TOTAL TRAFFIC

Figure 8a shows the 2025 weekday total traffic which is the sum of the 2025 weekday background traffic volumes (from Figure 4a) and the weekday site-generated traffic volumes (from Figure 7a). Figure 8a also shows the recommended lane geometry and traffic control.

Figure 8b shows the 2025 Saturday total traffic which is the sum of the 2025 Saturday background traffic volumes (from Figure 4b) and the weekend site-generated traffic volumes (from Figure 7b). Figure 8b also shows the recommended lane geometry and traffic control.

Figure 8c shows the 2025 Sunday total traffic which is the sum of the 2025 Sunday background traffic volumes (from Figure 4c) and the weekend site-generated traffic volumes (from Figure 7b). Figure 8c also shows the recommended lane geometry and traffic control.

Figure 9a shows the 2043 weekday total traffic which is the sum of the 2043 weekday background traffic volumes (from Figure 5a) and the weekday site-generated traffic volumes (from Figure 7a). Figure 9a also shows the recommended lane geometry and traffic control.

Figure 9b shows the 2043 Saturday total traffic which is the sum of the 2043 Saturday background traffic volumes (from Figure 5b) and the weekend site-generated traffic volumes (from Figure 7b). Figure 9b also shows the recommended lane geometry and traffic control.

Figure 9c shows the 2043 Sunday total traffic which is the sum of the 2043 Sunday background traffic volumes (from Figure 5c) and the weekend site-generated traffic volumes (from Figure 7b). Figure 9c also shows the recommended lane geometry and traffic control.

PROJECTED LEVELS OF SERVICE

The intersections in Figures 8a through 9c were analyzed to determine the 2025 and 2043 total traffic levels of service. Table 1a shows the existing and 2025 total level of service analysis results and Table 1b shows the 2043 total level of service results. The level of service reports are attached.

- 1. Shadow Mountain Drive/County Highway 73:** All movements at this unsignalized intersection are expected to operate at LOS “D” or better during all five scenarios through 2043 with the following exception: The northeastbound left-turn movement is expected to operate at LOS “E” or “F” during three of the five scenarios by 2025. By 2043, the intersection is planned to be converted to a modern roundabout by Jefferson County and is expected to operate at an overall LOS “B” or better during all scenarios.
- 2. County Highway 73/Barkley Road:** All movements at this unsignalized intersection are expected to operate at LOS “D” or better during all five scenarios through 2043 with the following exception: The southwestbound left-turn movement is expected to operate at LOS “E” or “F” during four of the five scenarios in 2025 and 2043. By 2043, the intersection is planned to be converted to a modern roundabout by Jefferson County and is expected to operate at an overall LOS “C” or better during all scenarios.
- 3. Shadow Mountain Drive/Site Access:** All movements at this unsignalized intersection are expected to operate at LOS “A” during all five scenarios through 2043.

CONCLUSIONS AND RECOMMENDATIONS

Trip Generation

1. The site is projected to generate about 520 vehicle-trips on the average weekday, with about half entering and half exiting during a 24-hour period. During the morning peak-hour, about 115 vehicles would enter and about 11 vehicles would exit the site. During the afternoon peak-hour, about 8 vehicles would enter and about 80 vehicles would exit.
2. On the average Saturday and Sunday, the site is projected to generate up to about 1,000 vehicle-trips with about half entering and half exiting during a 24-hour period. During the morning peak-hour, about 220 vehicles would enter and about 21 vehicles would exit the site. During the mid-day peak-hour, about 15 vehicles would enter and about 155 vehicles would exit

Projected Levels of Service

3. All movements at the unsignalized intersections analyzed are expected to operate at LOS “D” or better through 2043 in all five scenarios with the following exceptions: The north-eastbound left-turn movement at the Shadow Mountain Drive/County Highway 73 and the southwestbound left-turn movement at the County Highway 73/Barkley Road inter-

section are expected to operate at LOS “E” or “F” during several of the five scenarios. By 2043, both intersections are planned to be converted to modern roundabouts and are expected to operate at an overall LOS “C” or better during all scenarios. It is important to note that minimal site traffic is expected to make the movements with poor levels of service.

Recommendations

- 4. The recommended improvements to mitigate poor levels of service are shown in Figure 10. These future roundabouts are planned by Jefferson County; the Applicant would work with the County to agree upon a contribution for these improvements. Figure 10 shows the peak season site-generated trips will comprise about 15 percent of Saturday peak-hour trips at the northern roundabout and about 12 percent at the southern roundabout. These percentages will be lower on weekdays and during the off-season.
- 5. The recommended improvements at the site access intersection are per feedback from Jefferson County and are shown in Figures 8a through 8c and 9a through 9c. The west-bound left-turn lane is a requirement per the County’s feedback. The potential acceleration lane will provide minimal benefit so should be discussed further with County staff as the project moves forward.

* * * * *

We trust our findings will assist you in gaining approval of the proposed Shadow Mountain Bike Park development. Please contact me if you have any questions or need further assistance.

Sincerely,

LSC TRANSPORTATION CONSULTANTS, INC.

By  _____
 Christopher S. McGranahan, PE
 Principal/Professional Engineer



CSM/wc 4-3-24

- Enclosures: Tables 1a through 2
 Figures 1 - 10
 Traffic Count Reports
 Level of Service Definitions
 Level of Service Reports

**Table 1a
Intersection Levels of Service Analysis - Existing and 2025
Shadow Mountain Bike Park
Jefferson County, CO
LSC #220850; April, 2024**

Intersection No. & Location	Traffic Control	Existing Traffic					2025 Background					2025 Total - Scenario 1 ⁽¹⁾⁽²⁾					2025 Total - Scenario 2 ⁽¹⁾⁽²⁾				
		Weekday	Saturday		Sunday		Weekday	Saturday		Sunday		Weekday	Saturday		Sunday		Weekday	Saturday		Sunday	
		Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day	Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day	Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day	Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day
1) <u>Shadow Mountain Drive/County Highway 73</u>	TWSC																				
NEB Left		D	C	D	B	C	D	C	D	B	C	F	E	E	D	D	F	E	E	D	D
NEB Right		B	B	B	B	B	B	B	B	B	B	B	B	C	B	B	B	B	C	B	B
NWB Left		A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	B	A	A	A	A
Critical Movement Delay		30.4	17.2	30.7	14.7	22.6	31.7	17.5	32.4	14.9	23.5	50.6	36.8	39.0	30.4	26.8	50.6	36.8	39.0	30.4	26.8
2) <u>County Highway 73/Barkley Road</u>	TWSC																				
SEB Left		A	A	B	A	A	A	A	B	A	A	A	A	B	A	A	A	A	B	A	A
SWB Left		F	D	F	C	D	F	E	F	C	D	F	E	F	C	E	F	E	F	C	E
SWB Right		B	B	B	B	B	B	B	B	B	B	C	B	B	B	B	C	B	B	B	B
Critical Movement Delay		74.3	33.8	186.0	18.2	25.9	86.1	37.6	233.5	18.8	27.4	102.8	48.1	>240	20.8	49.8	102.8	48.1	>240	20.8	49.8
3) <u>Shadow Mountain Drive/Site Access</u>	TWSC																				
NB Approach		--	--	--	--	--	--	--	--	--	--	A	A	A	A	A	A	A	A	A	A
WB Left		--	--	--	--	--	--	--	--	--	--	A	A	A	A	A	A	A	A	A	A
Critical Movement Delay		--	--	--	--	--	--	--	--	--	--	8.7	8.9	9.8	8.9	9.7	7.6	7.9	7.5	7.9	7.5

(1) Scenario 1 assumes the construction of a WB left-turn lane on Shadow Mountain Road approaching the site access. Scenario 2 assumes the construction of a WB left-turn lane on Shadow Mountain Road approaching the site access and a right-turn acceleration lane on Shadow Mountain Road departing the site access.
(2) Intersection #3: The critical movement delay is for the NB approach in Scenario 1 and for the WB left in Scenario 2.

**Table 1b
Intersection Levels of Service Analysis
Shadow Mountain Bike Park- 2043
Jefferson County, CO
LSC #220850; April, 2024**

Intersection No. & Location	Traffic Control	2043 Background					2043 Total - Scenario 1 ⁽¹⁾⁽²⁾					2043 Total - Scenario 2 ⁽¹⁾⁽²⁾				
		Weekday	Saturday		Sunday		Weekday	Saturday		Sunday		Weekday	Saturday		Sunday	
		Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day	Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day	Level of Service PM	Level of Service AM	Level of Service Mid-Day	Level of Service AM	Level of Service Mid-Day
1) <u>Shadow Mountain Drive/County Highway 73</u>	Roundabout	B	A	B	A	A	B	A	B	A	A	B	A	B	A	A
SEB Approach		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
NWB Approach		A	A	A	A	A	A	A	B	A	A	A	A	B	A	A
NEB Approach		9.1	6.1	9.1	5.4	7.4	11.3	8.4	10.4	7.4	8.1	11.3	8.4	10.4	7.4	8.1
Entire Intersection Delay		A	A	A	A	A	B	A	B	A	A	B	A	B	A	A
Entire Intersection LOS																
2) <u>County Highway 73/Barkley Road</u>	Roundabout	B	A	B	A	A	B	A	C	A	A	B	A	C	A	A
SEB Approach		A	A	C	A	A	A	A	D	A	B	A	A	D	A	B
NWB Approach		B	A	A	A	A	B	B	A	A	A	B	B	A	A	A
SWB Approach		10.4	7.8	13.5	5.9	8.0	11.6	9.9	20.0	7.0	9.6	11.6	9.9	20.0	7.0	9.6
Entire Intersection Delay		B	A	B	A	A	B	A	C	A	A	B	A	C	A	A
Entire Intersection LOS																
3) <u>Shadow Mountain Drive/Site Access</u>	TWSC	--	--	--	--	--	A	A	A	A	A	A	A	A	A	A
NB Approach		--	--	--	--	--	A	A	A	A	A	A	A	A	A	A
WB Left		--	--	--	--	--	8.8	8.9	9.9	8.9	9.8	7.6	7.9	7.5	7.9	7.5
Critical Movement Delay																

(1) Scenario 1 assumes the construction of a WB left-turn lane on Shadow Mountain Road approaching the site access. Scenario 2 assumes the construction of a WB left-turn lane on Shadow Mountain Road approaching the site access and a right-turn acceleration lane on Shadow Mountain Road departing the site access.

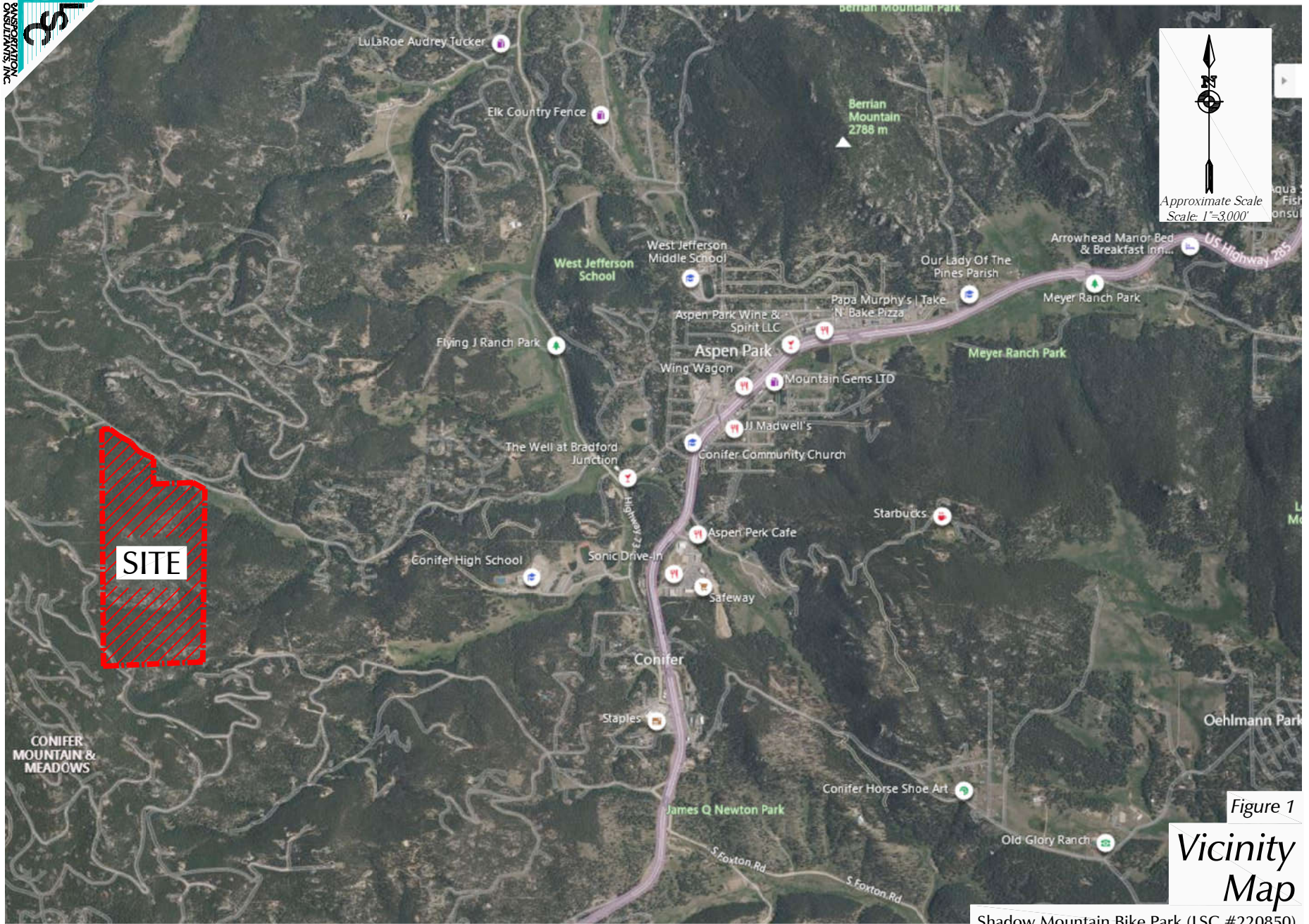
(2) Intersection #3: The critical movement delay is for the NB approach in Scenario 1 and for the WB left in Scenario 2.

Table 2
ESTIMATED TRAFFIC GENERATION
Shadow Mountain Bike Park
Jefferson County, CO
LSC #220850; April, 2024

Trip Generating Category	Vehicle-Trips Generated									
	Weekday					Saturday & Sunday				
	Daily ⁽¹⁾	AM Peak-Hour ⁽²⁾		PM Peak-Hour ⁽²⁾		Daily ⁽¹⁾	AM Peak-Hour ⁽²⁾		PM Peak-Hour ⁽²⁾	
		In	Out	In	Out		In	Out	In	Out
Guests	480	105	11	8	75	960	210	21	15	150
Employees	40	10	0	0	5	40	10	0	0	5
Total ⁽³⁾ =	520	115	11	8	80	1,000	220	21	15	155

Notes:

- (1) Assumes 300 parking spaces and a 1.6 turn over ratio for a total of 480 round-trips on the weekend with half that usage on a typical weekday. Assumes 20 employees with 20 round-trips. A vehicle occupancy of 2.5 would result in 1,200 guests on a capacity day.
- (2) Assumes 70 percent of arrival trips occur during the weekday afternoon peak-hour or Saturday/Sunday morning peak-hour with ten percent being dropped off and 50 percent of departure trips occur during the weekend midday peak-hour with ten percent being dropped off. Assumes half of the employees arrive during the peak-hour and a quarter depart during the peak-hour.
- (3) The average daily traffic for the site during the peak season is expected to be between 520 and 1,000 trips considering most weekdays are expected to have 520 or fewer trips per day.

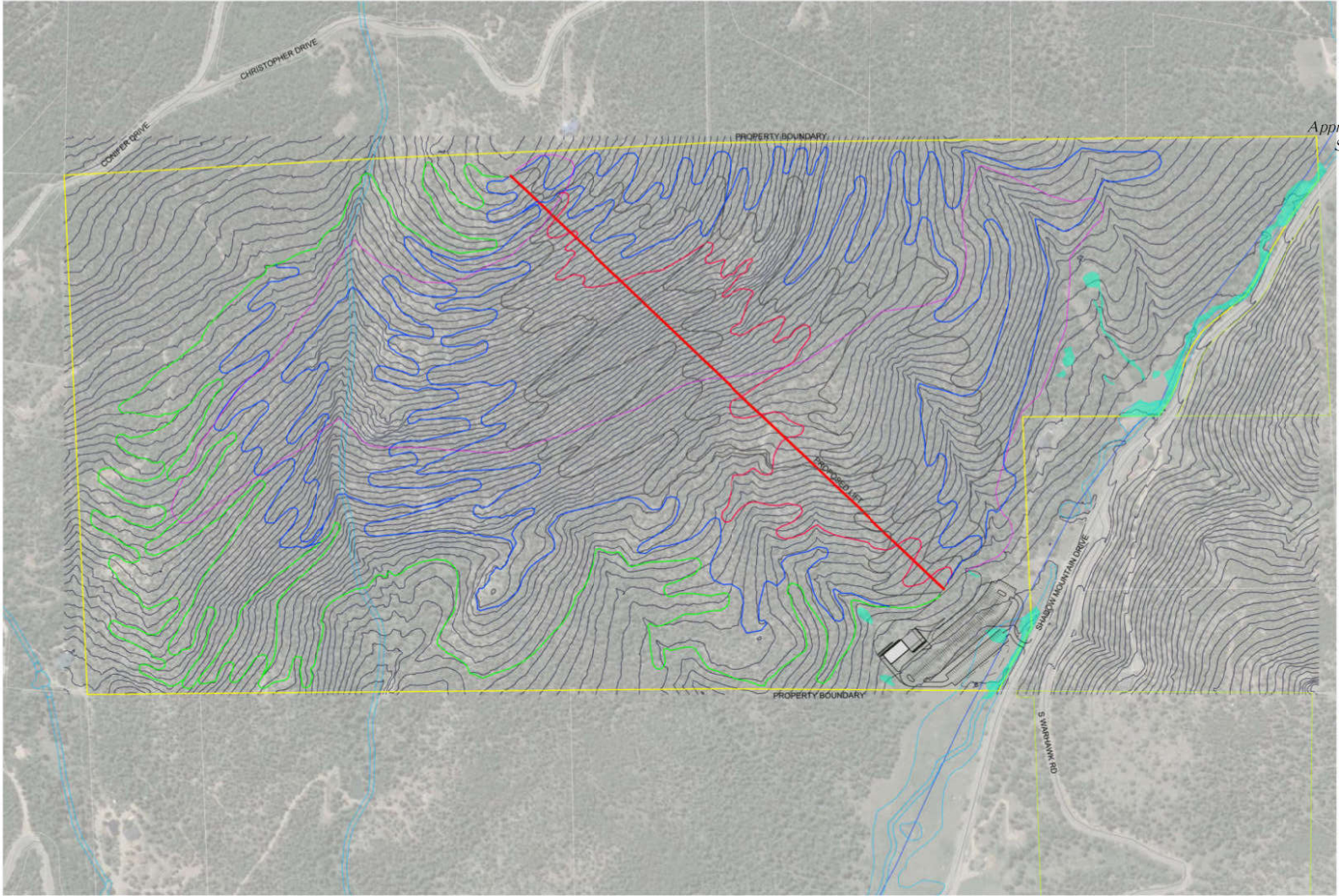


Approximate Scale
Scale: 1"=3,000'

Figure 1

Vicinity Map

Shadow Mountain Bike Park (LSC #220850)



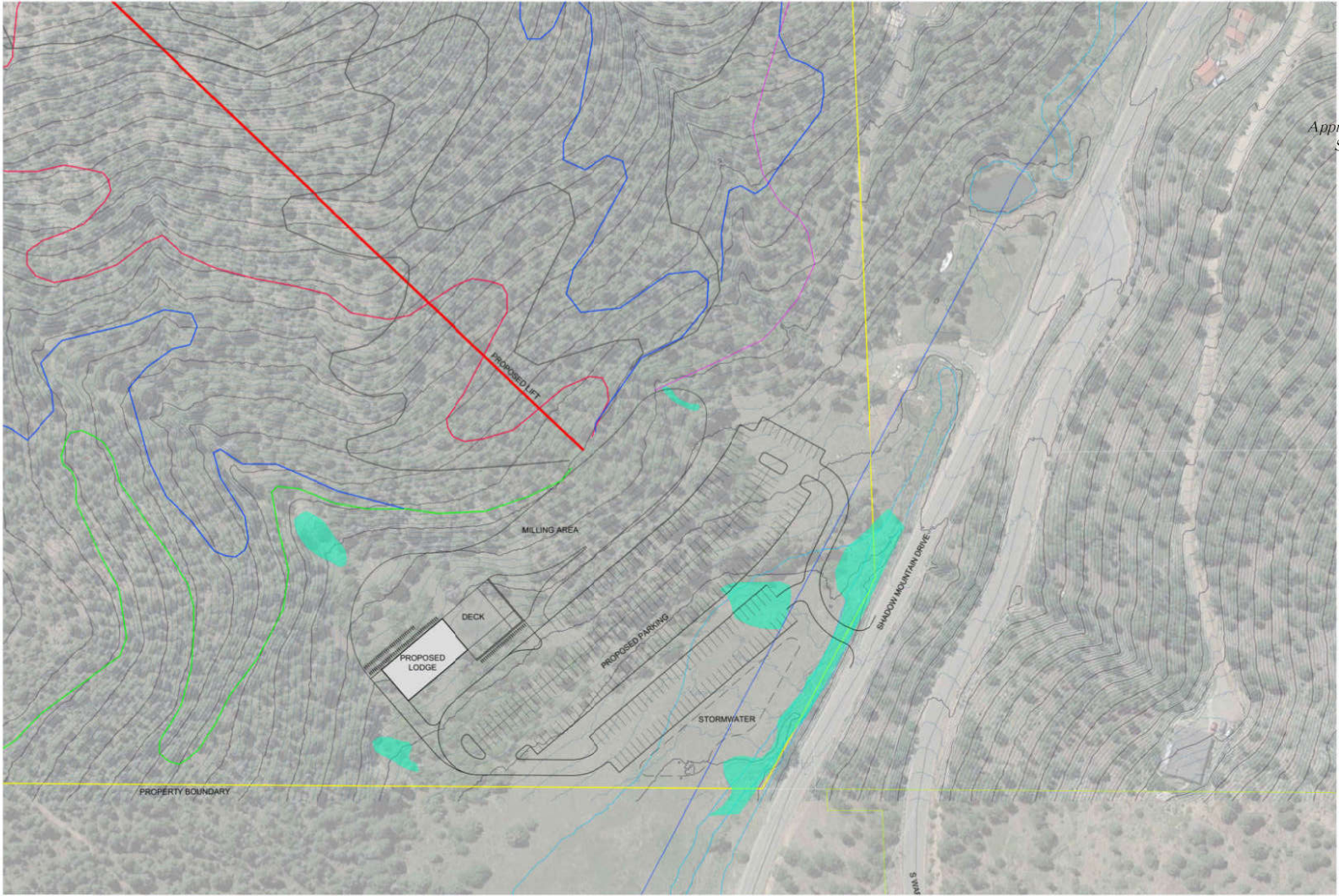
North Arrow
Approximate Scale
Scale: NTS

Figure 2a

Note: This site plan is conceptual in size, layout and location. It is subject to change through subsequent review processes.

Overall Site Plan

Shadow Mountain Bike Park (LSC #220850)



North Arrow
Approximate Scale
Scale: NTS

Figure 2b

Note: This site plan is conceptual in size, layout and location. It is subject to change through subsequent review processes.

Parking Lot & Access Detail

Shadow Mountain Bike Park (LSC #220850)



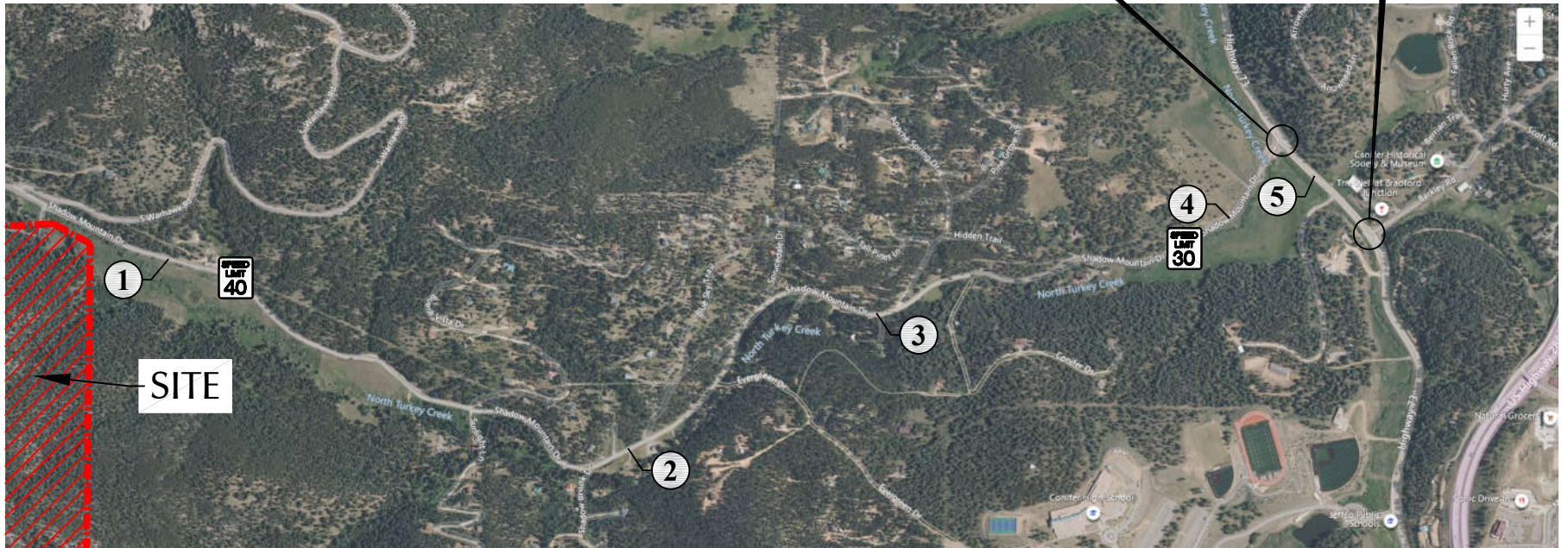
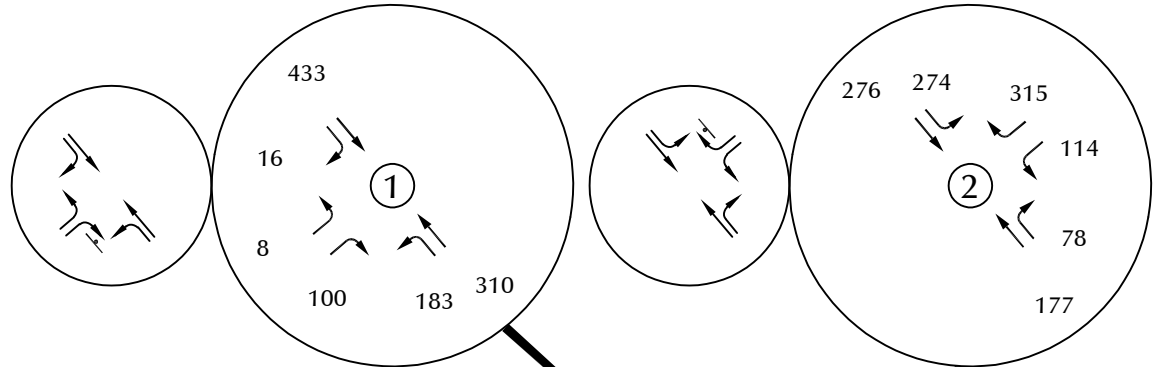
Approximate Scale
Scale: 1"=1,200'

LEGEND:

⊥ = Stop Sign

30 = Weekday Afternoon Peak Hour Traffic (4:45–5:45pm)

= Posted Speed Limit



①	Tues 8/23/2022 = 2,455	②	Tues 8/23/2022 = 2,680	③	Tues 8/23/2022 = 3,170	④	Tues 8/23/2022 = No Data	⑤	Tues 8/23/2022 = 11,390
	Wed 8/24/2022 = 2,525		Wed 8/24/2022 = 2,750		Wed 8/24/2022 = 3,220		Wed 8/24/2022 = No Data		Wed 8/24/2022 = 11,380
	Thur 8/25/2022 = 2,405		Thur 8/25/2022 = 2,655		Thur 8/25/2022 = 3,120		Thur 8/25/2022 = 3,155		Thur 8/25/2022 = 11,205
	Fri 8/26/2022 = 2,365		Fri 8/26/2022 = 2,625		Fri 8/26/2022 = 3,125		Fri 8/26/2022 = 3,160		Fri 8/26/2022 = 11,470

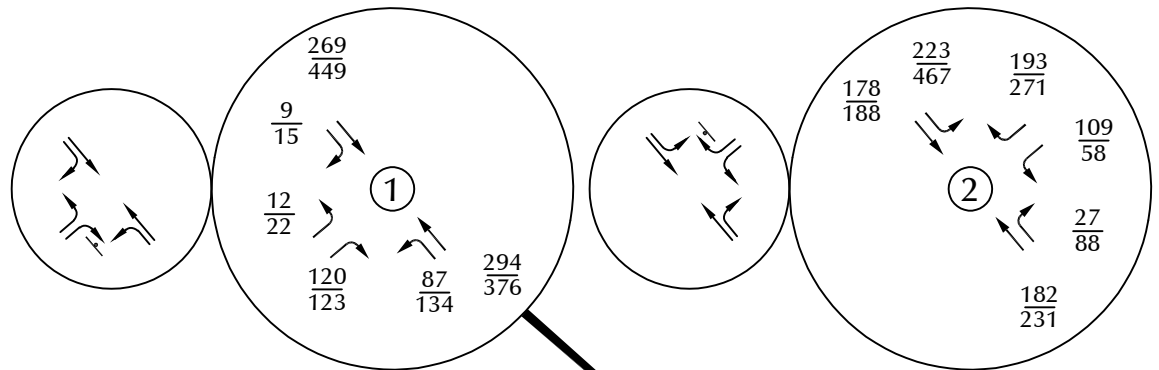
Figure 3a

Existing Weekday Peak Hour & All Daily Traffic

Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:



-  = Stop Sign
- $\frac{26}{35}$ = Saturday Morning Peak Hour Traffic (9:00am-10:00am)
- $\frac{35}{30}$ = Saturday Midday Peak Hour Traffic (12:00pm-1:00pm)
- $\frac{30}{40}$ = Saturday Peak Hour Traffic
-  = Posted Speed Limit

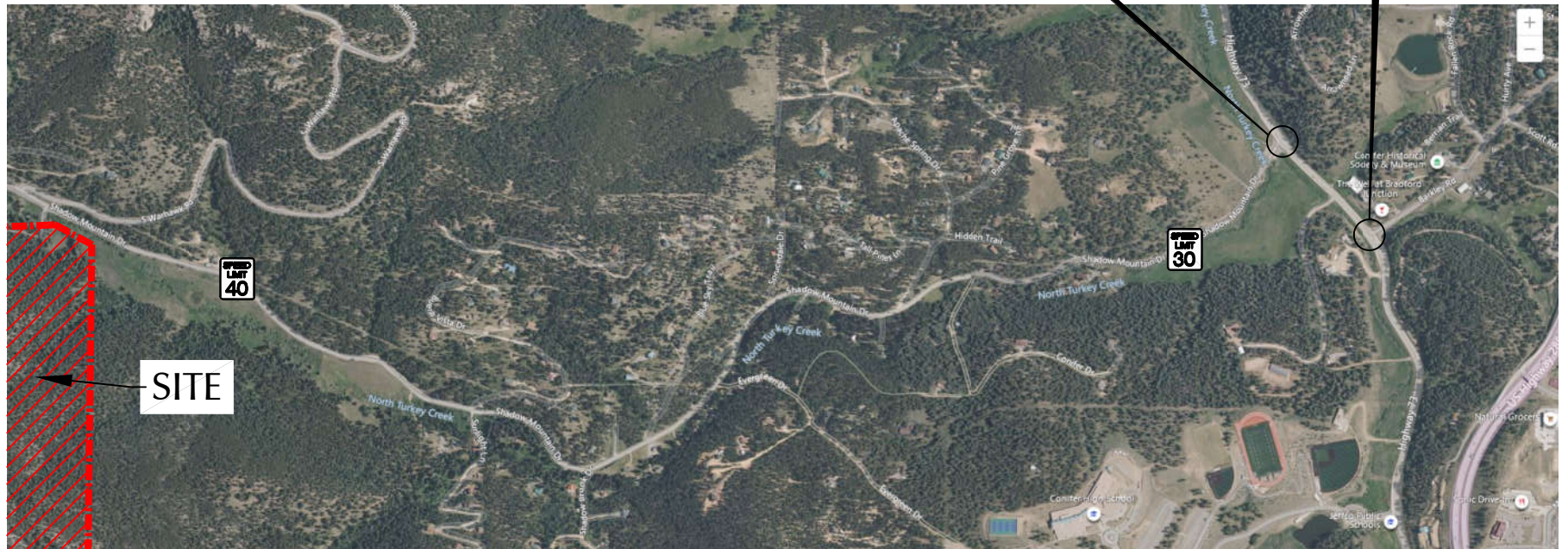
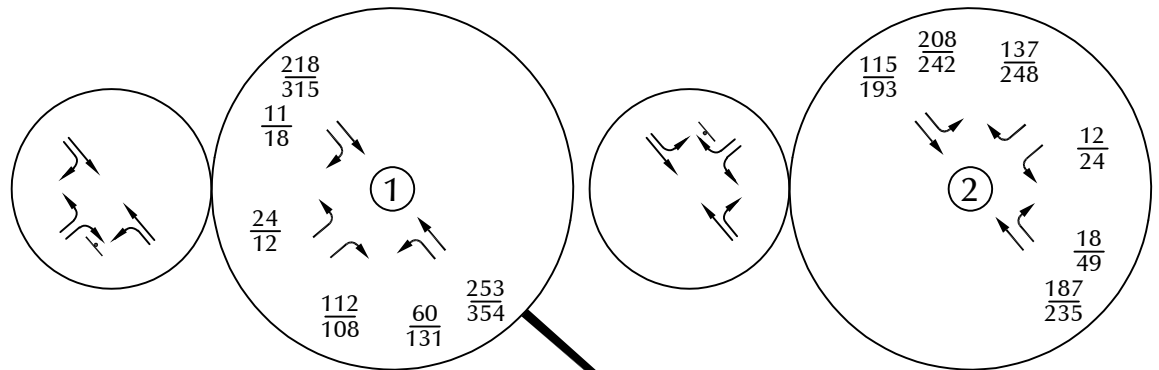
Figure 3b

Existing Saturday Peak Hour Traffic

Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:

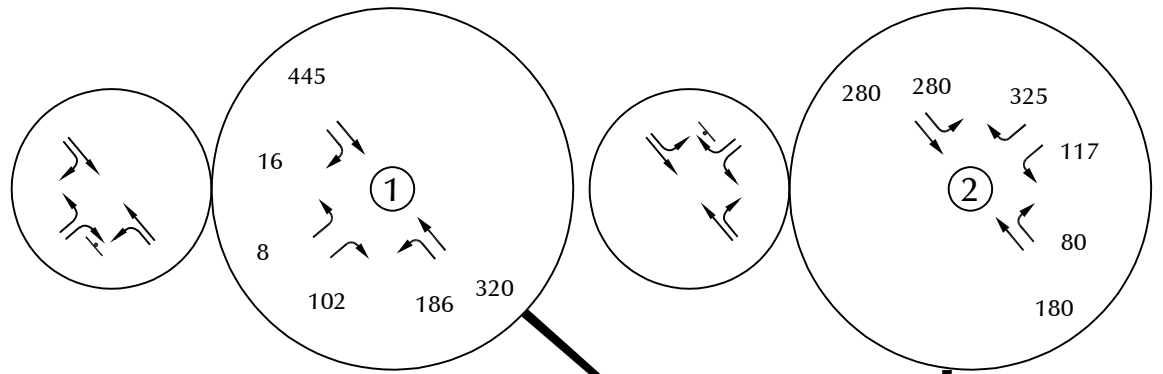
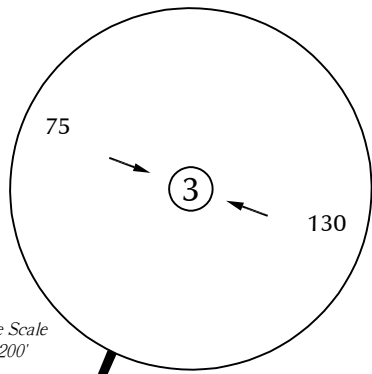
- ⊥ = Stop Sign
- $\frac{26}{35}$ = Sunday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Sunday Middy Peak Hour Traffic (12:30pm–1:30pm)
- = Posted Speed Limit

Figure 3c

Existing Sunday Peak Hour Traffic

Shadow Mountain Bike Park (LSC #220850)

Approximate Scale
Scale: 1"=1,200'



LEGEND:

⊥ = Stop Sign

30 = Weekday Afternoon Peak Hour Traffic (4:45–5:45pm)

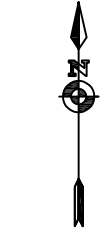
Note: Assumes annual growth rate of one half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road to maintain a conservative analysis because DRCOG model predicts little or no growth on Shadow Mountain Drive.

DRCOG = Denver Regional Council of Governments

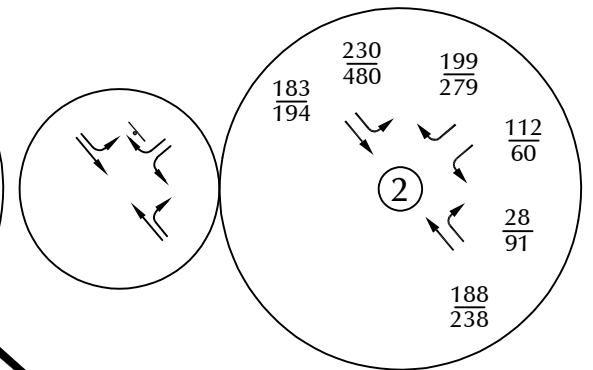
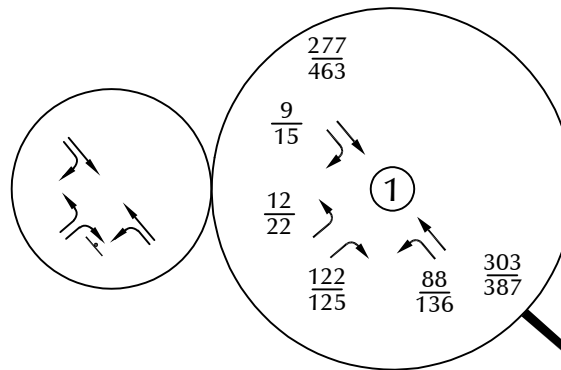
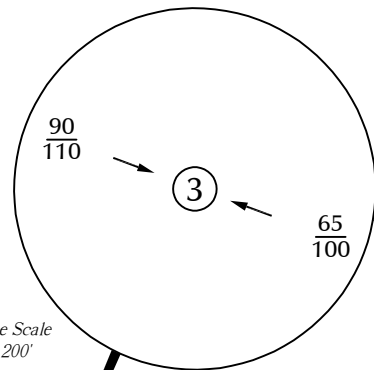
Figure 4a

Year 2025 Weekday Background Traffic

Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:

‡ = Stop Sign

$\frac{26}{35}$ = Saturday Morning Peak Hour Traffic (9:00am–10:00am)

$\frac{35}{26}$ = Saturday Midday Peak Hour Traffic (12:00pm–1:00pm)

Note: Assumes annual growth rate of one half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road to maintain a conservative analysis because DRCOG model predicts little or no growth on Shadow Mountain Drive.

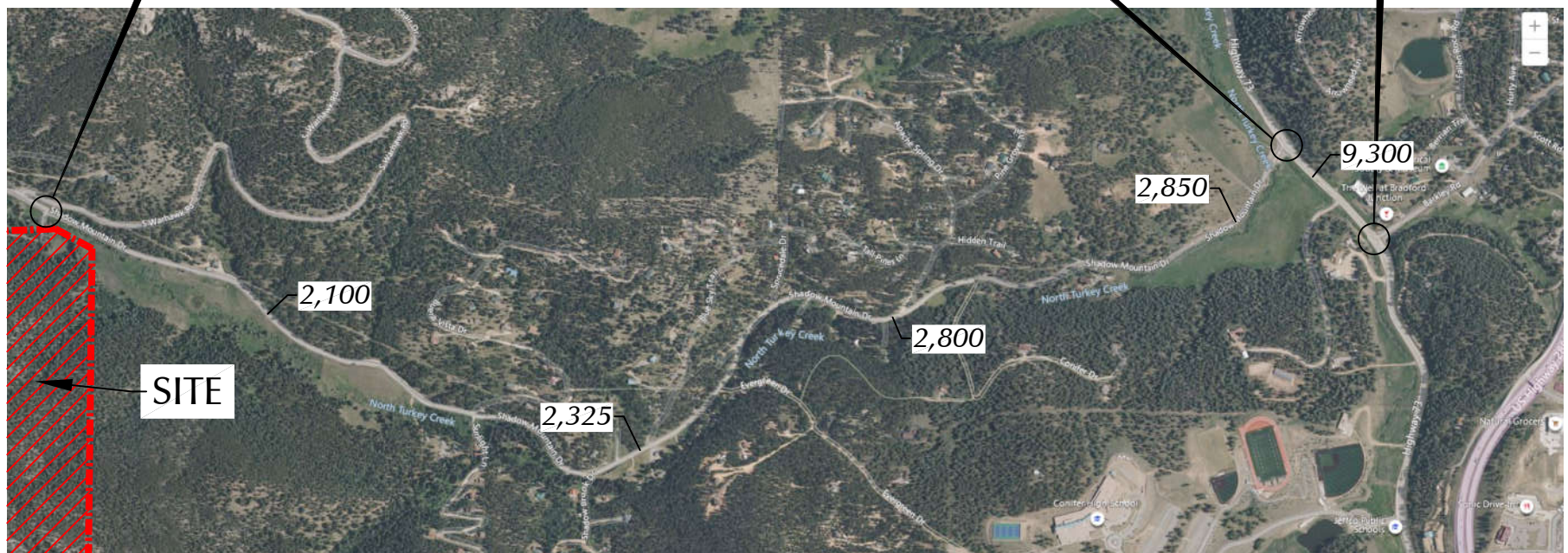
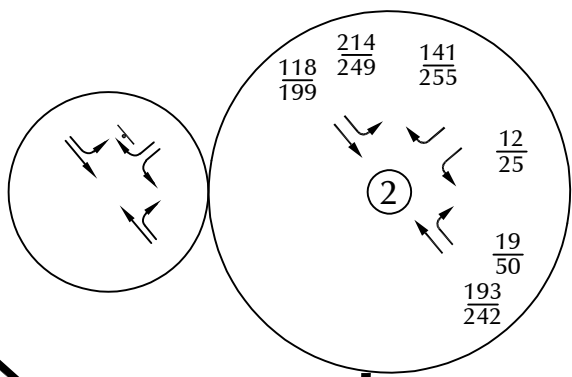
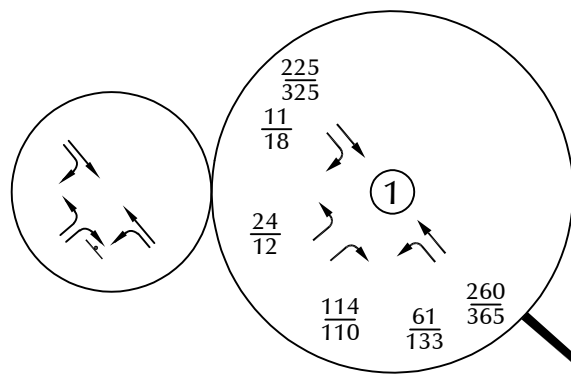
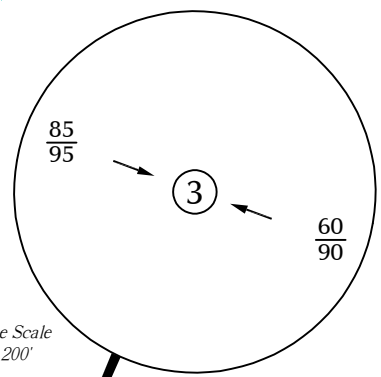
DRCOG = Denver Regional Council of Governments

Figure 4b

Year 2025 Saturday Background Traffic

Shadow Mountain Bike Park (LSC #220850)

Approximate Scale
Scale: 1"=1,200'



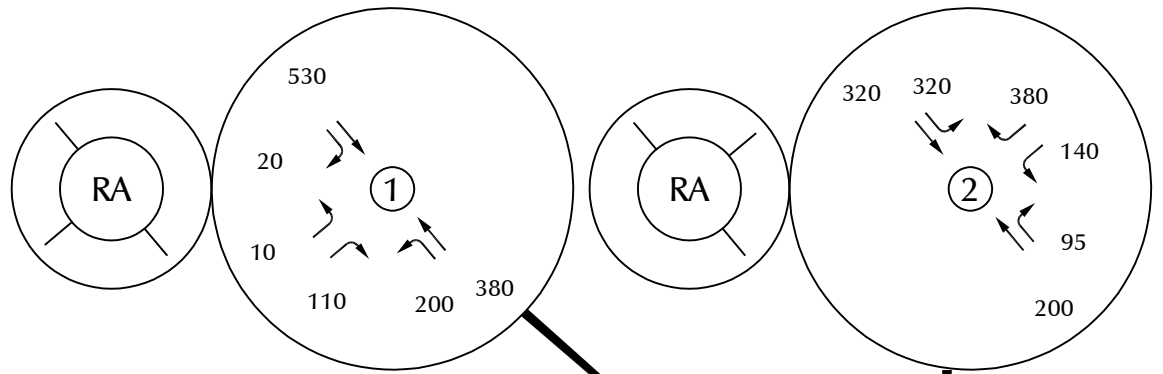
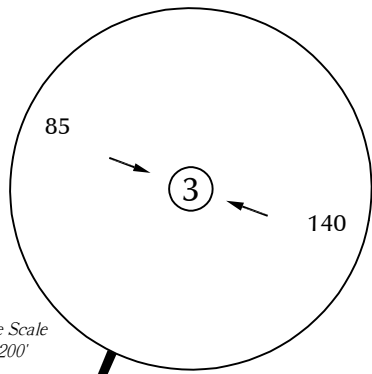
LEGEND:

- ⊥ = Stop Sign
- $\frac{26}{35}$ = Saturday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Saturday Midday Peak Hour Traffic (12:00pm–1:00pm)

Note: Assumes annual growth rate of one half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road to maintain a conservative analysis because DRCOG model predicts little or no growth on Shadow Mountain Drive. Daily volumes based on ratio of Saturday peak hour trips to Saturday daily trips.
DRCOG = Denver Regional Council of Governments

Figure 4c
Year 2025
Sunday Background Traffic
Shadow Mountain Bike Park (LSC #220850)

Approximate Scale
Scale: 1"=1,200'



LEGEND:

┆ = Stop Sign

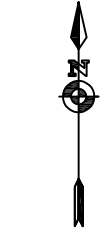
30 = Weekday Afternoon Peak Hour Traffic (4:45–5:45pm)

Notes:

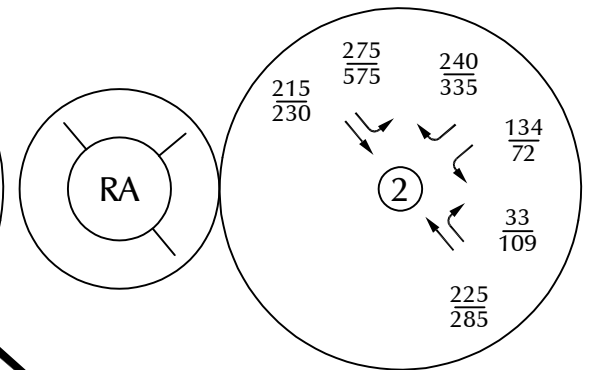
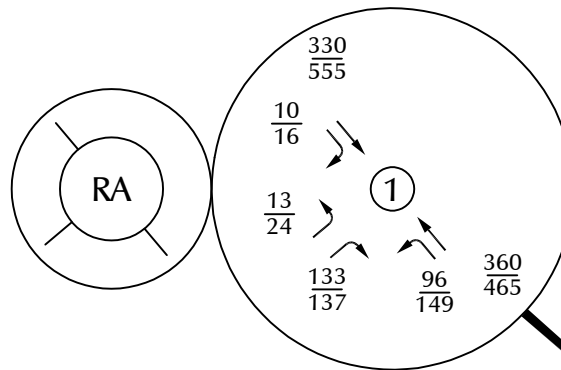
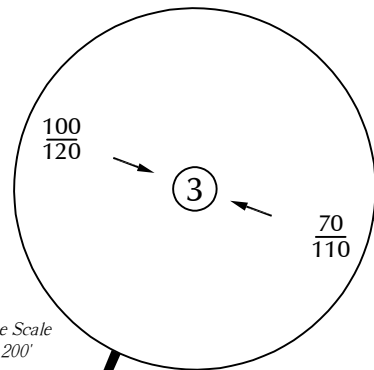
1. Assumes annual growth rate of one half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road.
2. Assumes roundabout control at Intersection #1 and #2 per feedback from Jefferson County.

Figure 5a

Year 2043
Weekday Background Traffic
Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:

⊥ = Stop Sign

$\frac{26}{35}$ = Saturday Morning Peak Hour Traffic (9:00am–10:00am)

$\frac{35}{26}$ = Saturday Midday Peak Hour Traffic (12:00pm–1:00pm)

Notes:

1. Assumes annual growth rate of one half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road.

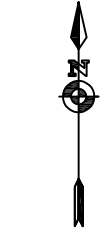
2. Assumes roundabout control at Intersection #1 and #2 per feedback from Jefferson County.

Figure 5b

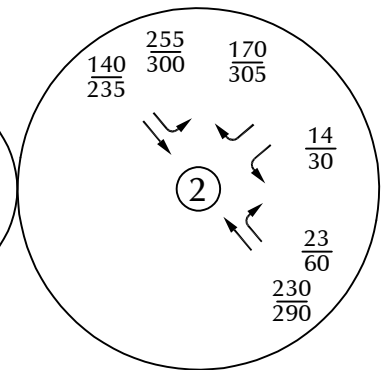
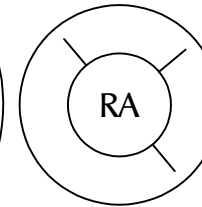
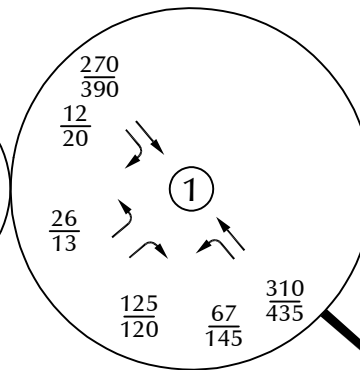
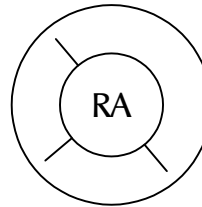
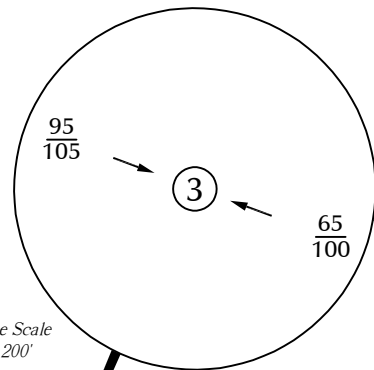
Year 2043

Saturday Background Traffic

Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:

- ↓ = Stop Sign
- $\frac{26}{35}$ = Sunday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Sunday Midday Peak Hour Traffic (12:30pm–1:30pm)

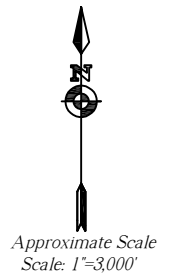
Notes:

1. Assumes annual growth rate of one half percent on Shadow Mountain Drive and one percent on Highway 73 and Barkley Road.
2. Assumes roundabout control at Intersection #1 and #2 per feedback from Jefferson County.

Figure 5c

Year 2043 Sunday Background Traffic

Shadow Mountain Bike Park (LSC #220850)



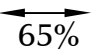
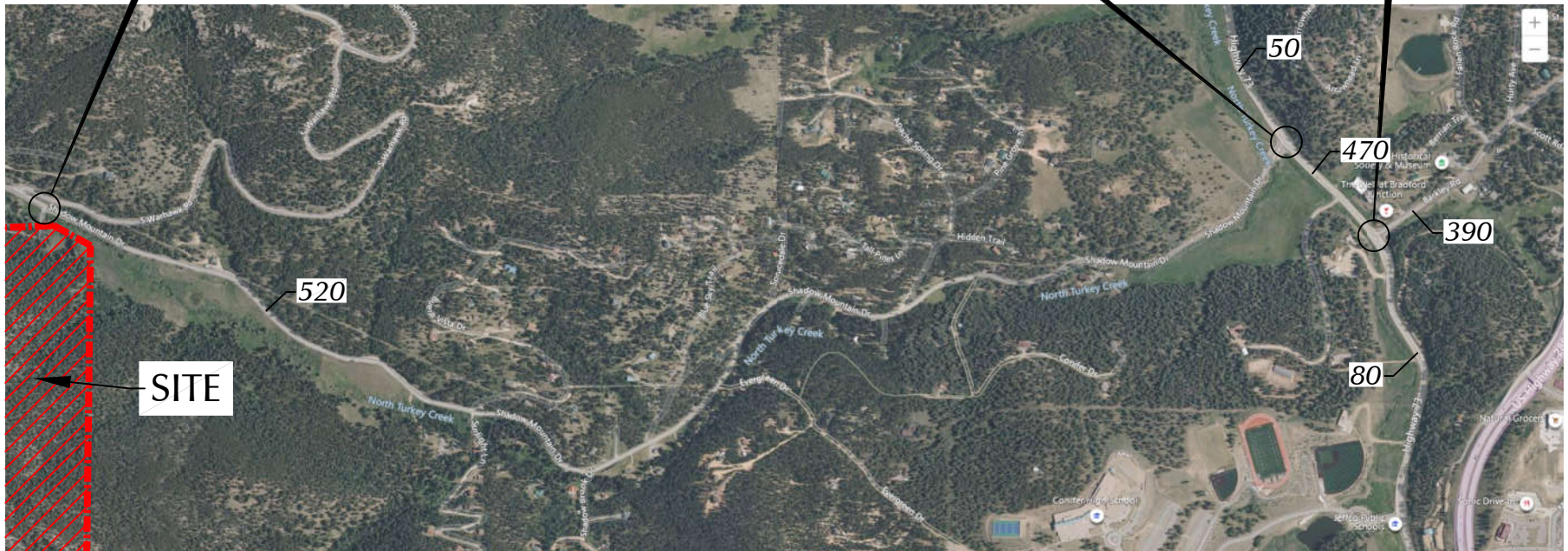
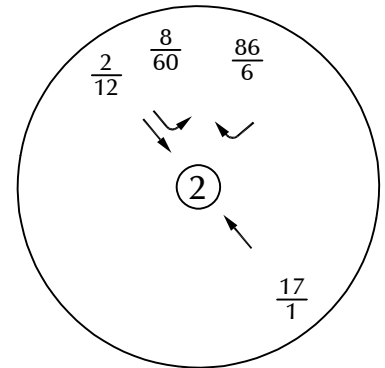
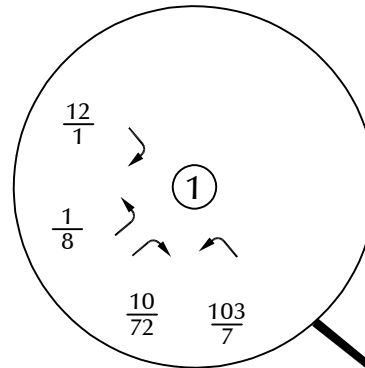
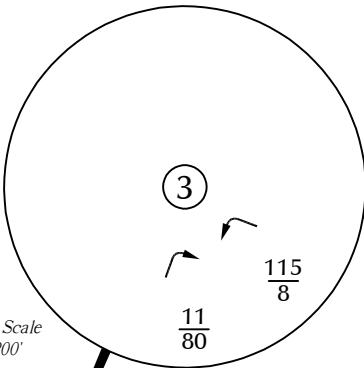
LEGEND:
 = Percent Directional Distribution

Figure 6
Directional Distribution of Site-Generated Traffic
 Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:

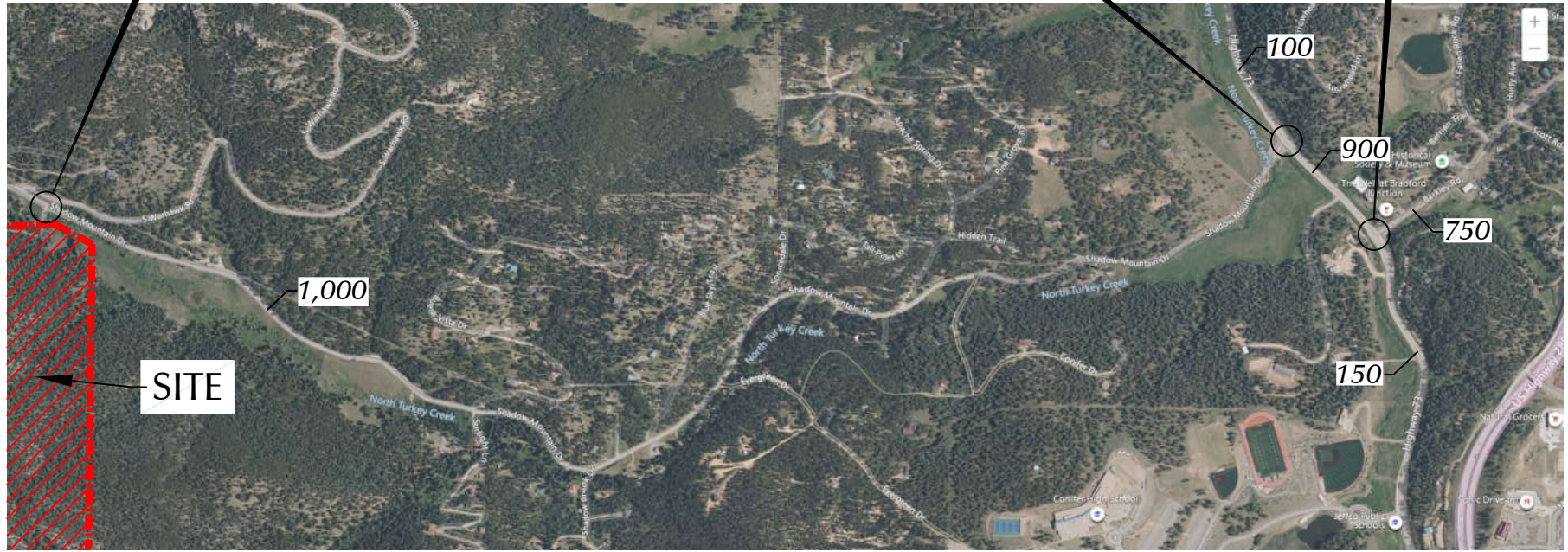
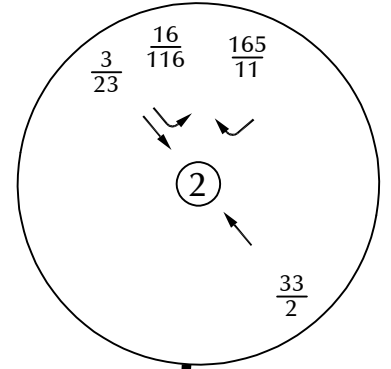
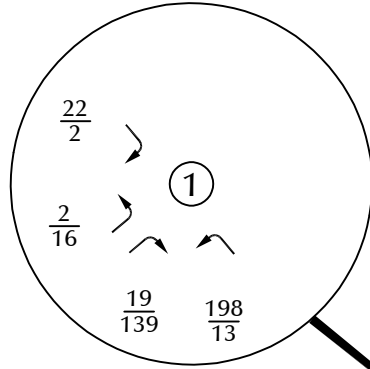
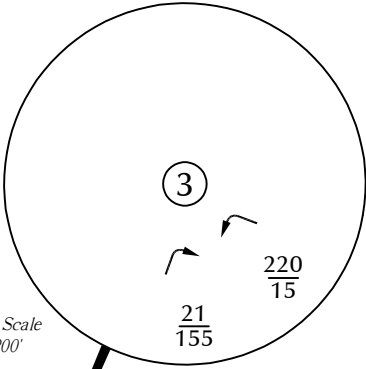
$\frac{26}{35}$ = Weekday Morning Peak Hour Traffic
 = Weekday Afternoon Peak Hour Traffic

Figure 7a

Assignment of Weekday Site-Generated Traffic

Shadow Mountain Bike Park (LSC #220850)

Approximate Scale
Scale: 1"=1,200'

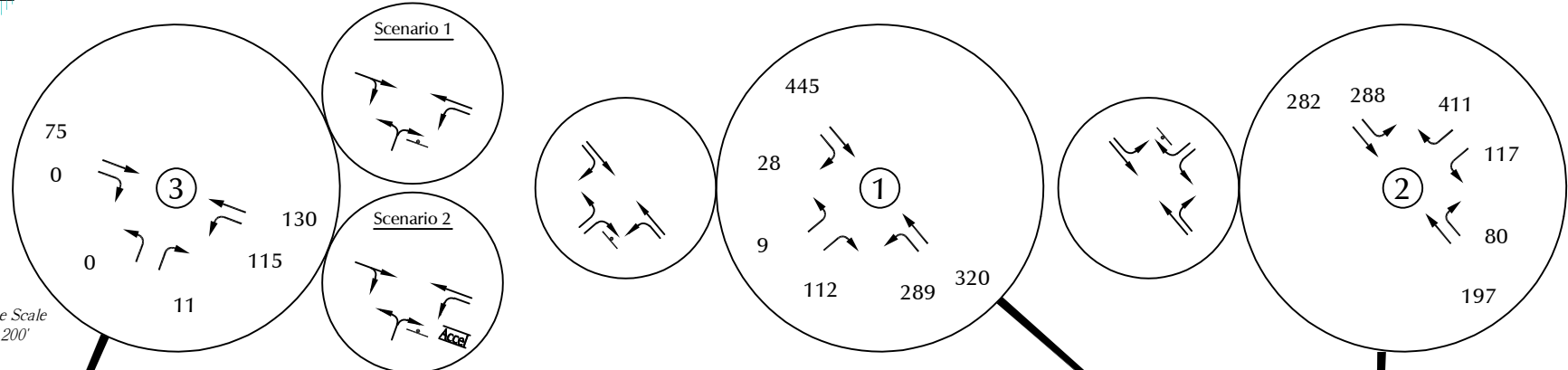


LEGEND:

$\frac{26}{35}$ = Weekend Morning Peak Hour Traffic
 = Weekend Afternoon Peak Hour Traffic

Figure 7b
**Assignment of
 Weekend Site-Generated Traffic**
 Shadow Mountain Bike Park (LSC #220850)

Approximate Scale
Scale: 1"=1,200'



LEGEND:

- ⌋ = Stop Sign
- 30 = Weekday Afternoon Peak Hour Traffic (4:45–5:45pm)

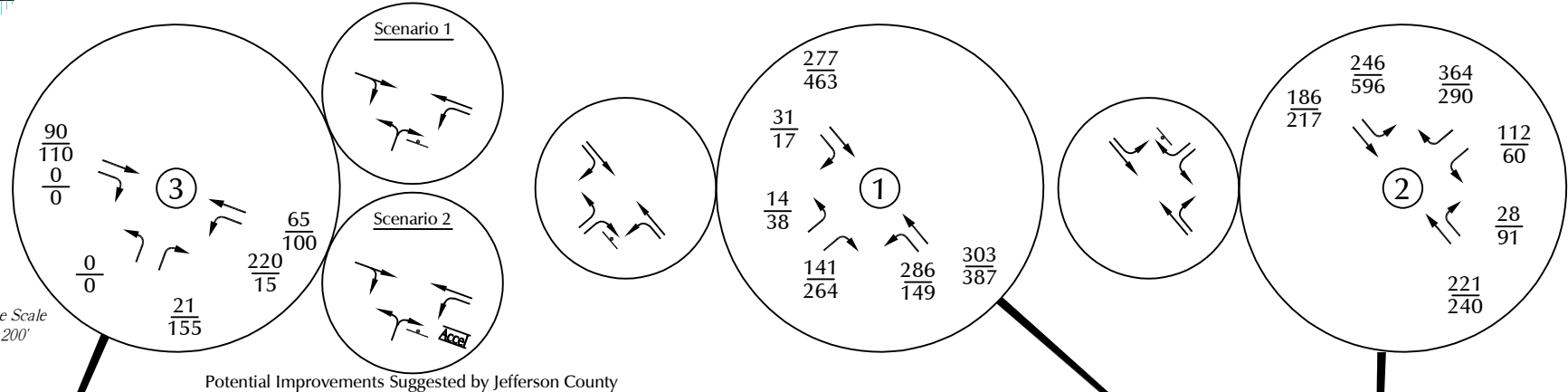
Notes:

1. These volumes are the sum of the volumes in Figures 4a and 7a.
2. The potential site access improvements suggested by Jefferson County are a left-turn lane for ingress and a right-turn acceleration lane for egress. The acceleration lane is not expected to provide much benefit but a left-turn lane for ingress could be beneficial if there are no existing constraints preventing it such as right-of-way or wetland limitations. An appropriate length for a left-turn lane would be 280 feet plus a 140-foot transition taper and 45:1 redirect taper. The appropriate length for a right-turn acceleration lane is 380 feet plus a 180-foot transition taper.

Figure 8a
Year 2025
Weekday Total Traffic
Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



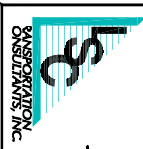
LEGEND:

- ⊥ = Stop Sign
- $\frac{26}{35}$ = Saturday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Saturday Midday Peak Hour Traffic (12:00pm–1:00pm)

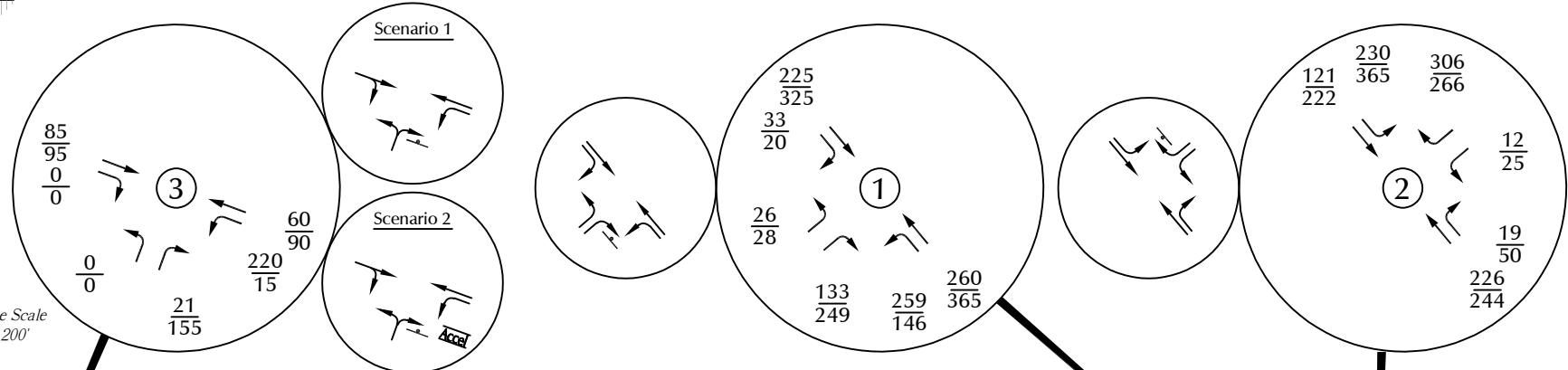
Notes:

1. These volumes are the sum of the volumes in Figures 4b and 7b.
2. The potential site access improvements suggested by Jefferson County are a left-turn lane for ingress and a right-turn acceleration lane for egress. The acceleration lane is not expected to provide much benefit but a left-turn lane for ingress could be beneficial if there are no existing constraints preventing it such as right-of-way or wetland limitations. An appropriate length for a left-turn lane would be 280 feet plus a 140-foot transition taper and 45:1 redirect taper. The appropriate length for a right-turn acceleration lane is 380 feet plus a 180-foot transition taper.

Figure 8b
Year 2025
Saturday Total Traffic
Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



Potential Improvements Suggested by Jefferson County



LEGEND:

- ⊥ = Stop Sign
- $\frac{26}{35}$ = Sunday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Sunday Midday Peak Hour Traffic (12:30pm–1:30pm)

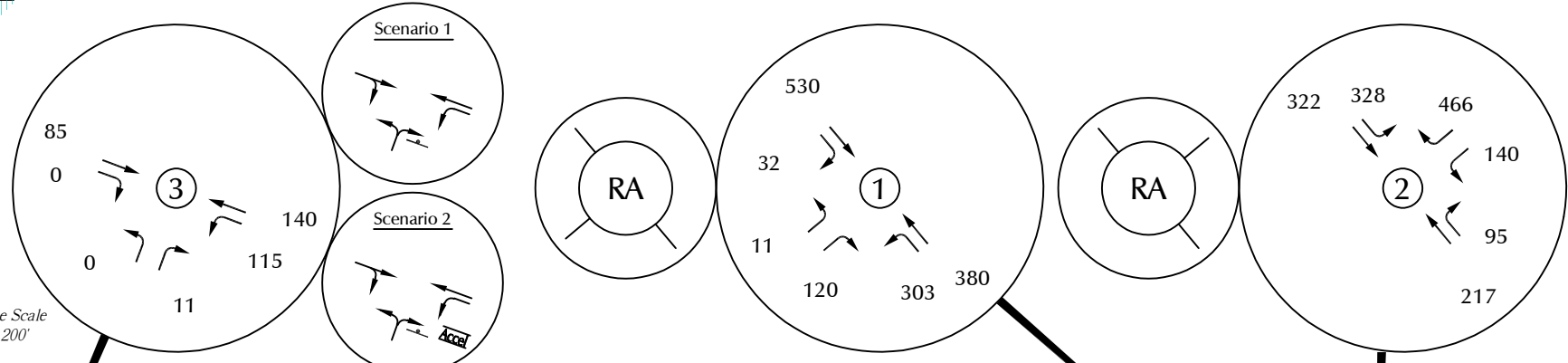
Notes:

1. These volumes are the sum of the volumes in Figures 4c and 7b.
2. The potential site access improvements suggested by Jefferson County are a left-turn lane for ingress and a right-turn acceleration lane for egress. The acceleration lane is not expected to provide much benefit but a left-turn lane for ingress could be beneficial if there are no existing constraints preventing it such as right-of-way or wetland limitations. An appropriate length for a left-turn lane would be 280 feet plus a 140-foot transition taper and 45:1 redirect taper. The appropriate length for a right-turn acceleration lane is 380 feet plus a 180-foot transition taper.

Figure 8c

Year 2025
Sunday Total Traffic
Shadow Mountain Bike Park (LSC #220850)

Approximate Scale
Scale: 1"=1,200'



Potential Improvements Suggested by Jefferson County



LEGEND:

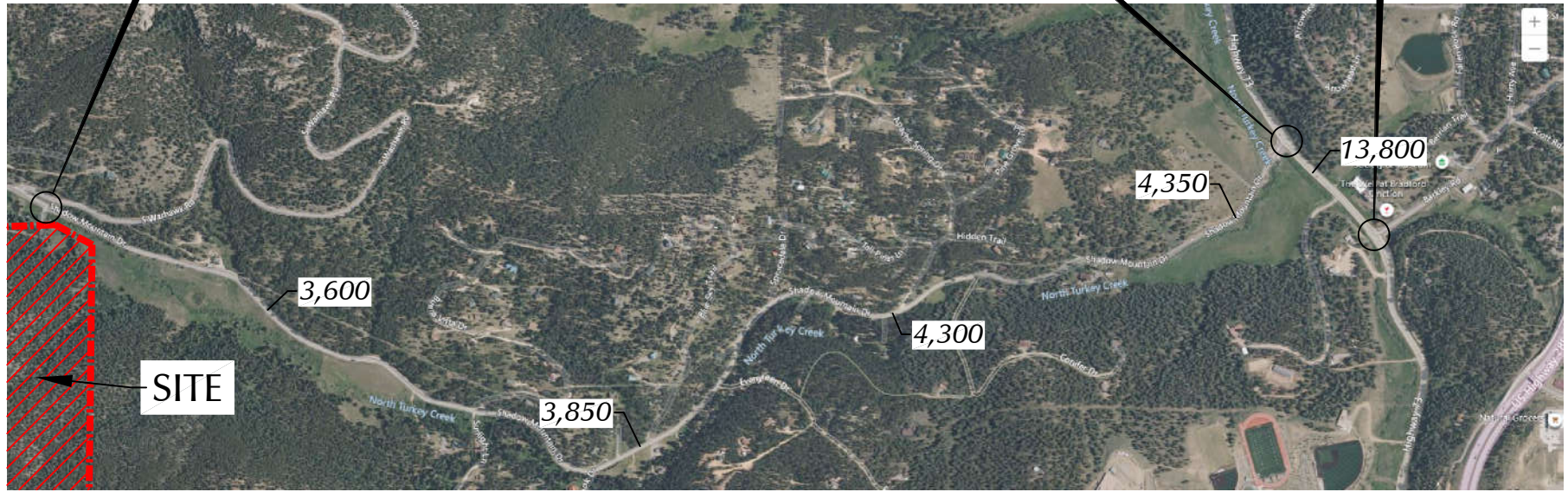
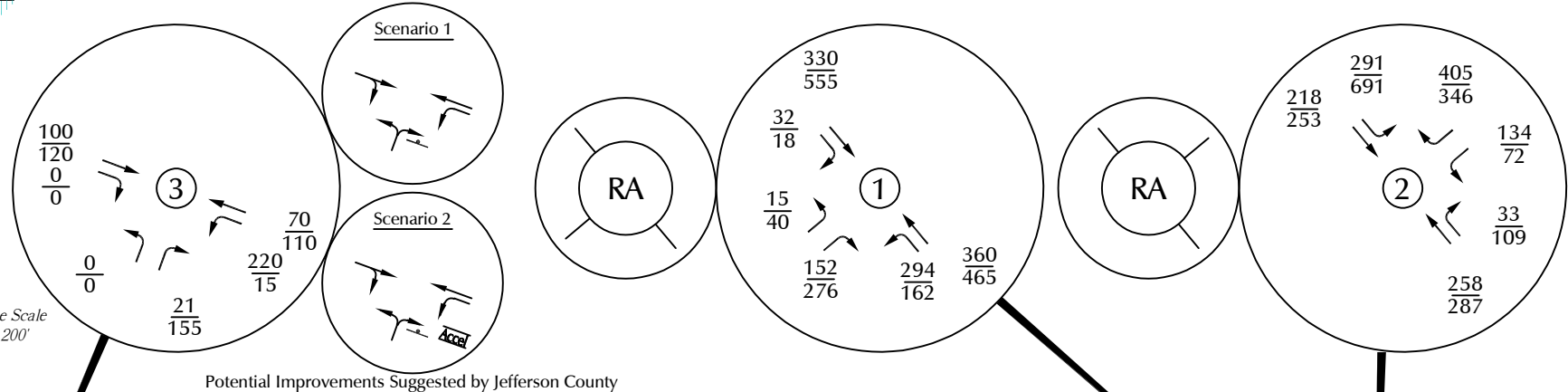
- ⊥ = Stop Sign
- 30 = Weekday Afternoon Peak Hour Traffic (4:45–5:45pm)

Notes:
 1. These volumes are the sum of the volumes in Figures 5a and 7a.
 2. The potential site access improvements suggested by Jefferson County are a left-turn lane for ingress and a right-turn acceleration lane for egress. The acceleration lane is not expected to provide much benefit but a left-turn lane for ingress could be beneficial if there are no existing constraints preventing it such as right-of-way or wetland limitations. An appropriate length for a left-turn lane would be 280 feet plus a 140-foot transition taper and 45:1 redirect taper. The appropriate length for a right-turn acceleration lane is 380 feet plus a 180-foot transition taper.

Figure 9a
Year 2043
Weekday Total Traffic
 Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



LEGEND:

- ↓ = Stop Sign
- $\frac{26}{35}$ = Saturday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Saturday Midday Peak Hour Traffic (12:00pm–1:00pm)

Notes:

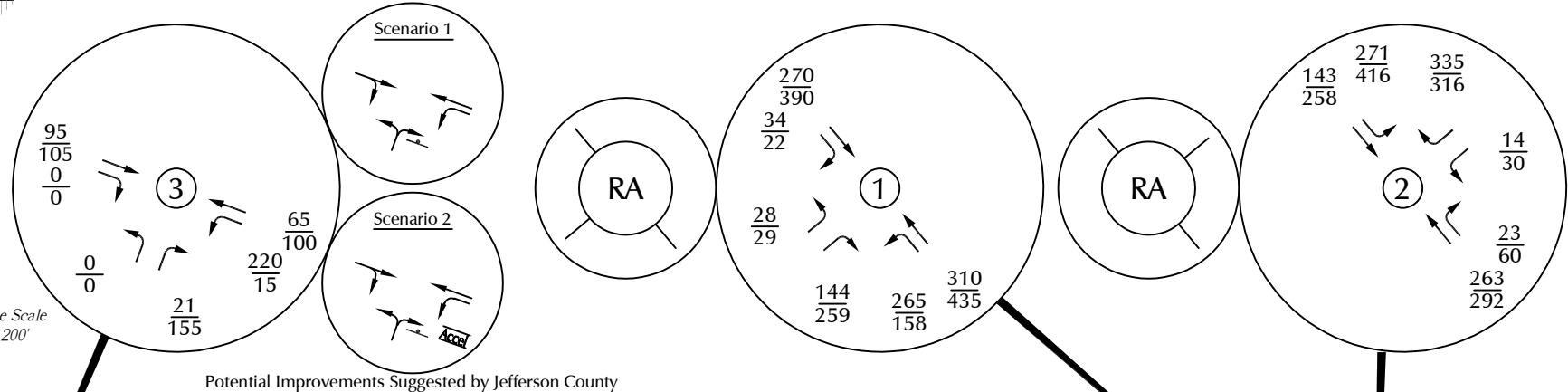
1. These volumes are the sum of the volumes in Figures 5b and 7b.
2. The potential site access improvements suggested by Jefferson County are a left-turn lane for ingress and a right-turn acceleration lane for egress. The acceleration lane is not expected to provide much benefit but a left-turn lane for ingress could be beneficial if there are no existing constraints preventing it such as right-of-way or wetland limitations. An appropriate length for a left-turn lane would be 280 feet plus a 140-foot transition taper and 45:1 redirect taper. The appropriate length for a right-turn acceleration lane is 380 feet plus a 180-foot transition taper.

Figure 9b

Year 2043
Saturday Total Traffic
Shadow Mountain Bike Park (LSC #220850)



Approximate Scale
Scale: 1"=1,200'



Potential Improvements Suggested by Jefferson County



LEGEND:

- ⊥ = Stop Sign
- $\frac{26}{35}$ = Sunday Morning Peak Hour Traffic (9:00am–10:00am)
- $\frac{35}{26}$ = Sunday Midday Peak Hour Traffic (12:30pm–1:30pm)

Notes:

1. These volumes are the sum of the volumes in Figures 5c and 7b.
2. The potential site access improvements suggested by Jefferson County are a left-turn lane for ingress and a right-turn acceleration lane for egress. The acceleration lane is not expected to provide much benefit but a left-turn lane for ingress could be beneficial if there are no existing constraints preventing it such as right-of-way or wetland limitations. An appropriate length for a left-turn lane would be 280 feet plus a 140-foot transition taper and 45:1 redirect taper. The appropriate length for a right-turn acceleration lane is 380 feet plus a 180-foot transition taper.

Figure 9c

Year 2043 Sunday Total Traffic

Shadow Mountain Bike Park (LSC #220850)



Notes:

1. The recommended mitigation over time is to construct a single lane roundabout at both locations consistent with feedback from Jefferson County.
2. Some of the potential design constraints are labeled above.
3. The site-generated trips are expected to comprise about 15 percent of Saturday peak hour trips by 2043 at CR73/Shadow Mountain Drive. This percentage will be much lower on weekdays and in the off-season.
4. The site-generated trips are expected to comprise about 12 percent of Saturday peak hour trips by 2043 at CR 73/Barkley Road. This percentage will be much lower on weekdays and in the off-season.

Figure 10

Potential Improvements Along CH 73 Based on County Feedback

Shadow Mountain Bike Park (LSC #220850)

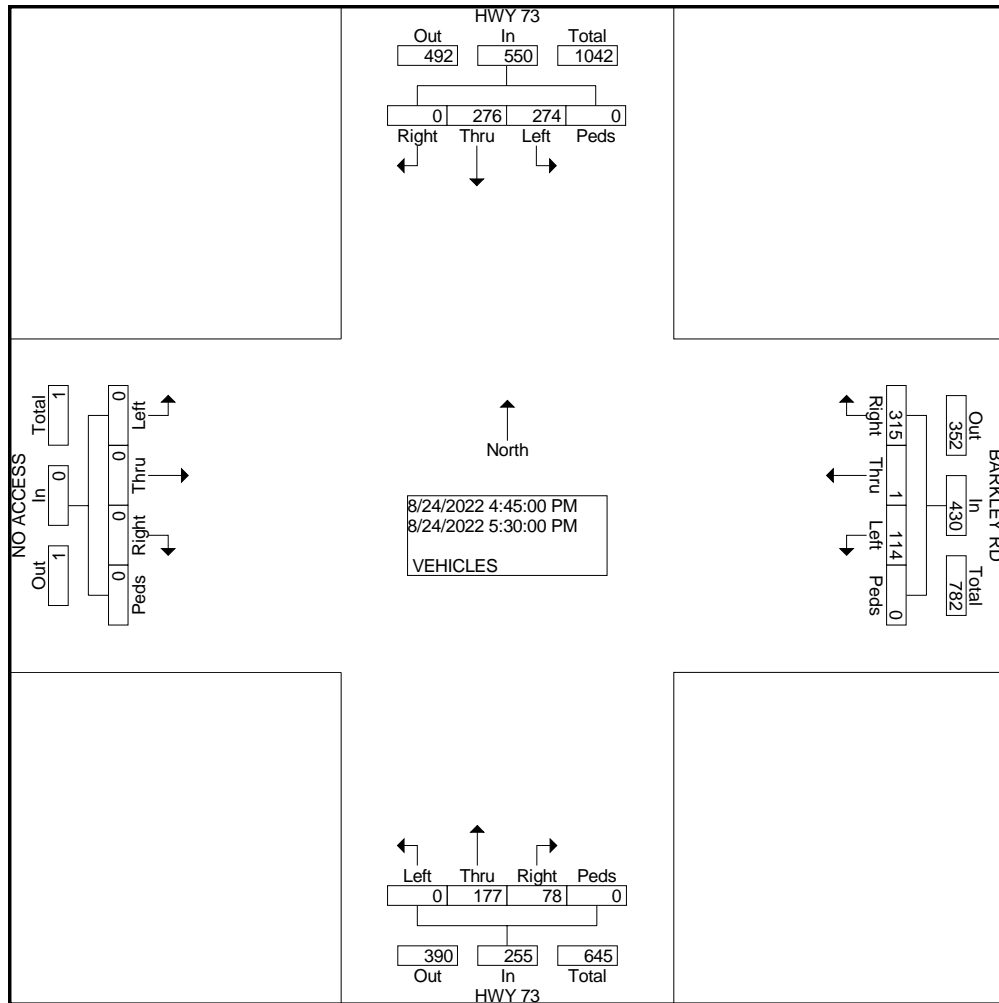
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK
Site Code : 00000025
Start Date : 8/24/2022
Page No : 2

Start Time	HWY 73 Southbound					BARKLEY RD Westbound					HWY 73 Northbound					NO ACCESS Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:45 PM																				
Volume	274	276	0	0	550	114	1	315	0	430	0	177	78	0	255	0	0	0	0	0	1235
Percent	49.8	50.2	0.0	0.0		26.5	0.2	73.3	0.0		0.0	69.4	30.6	0.0		0.0	0.0	0.0	0.0		
05:00 Volume	66	76	0	0	142	32	1	84	0	117	0	43	16	0	59	0	0	0	0	0	318
Peak Factor																					
High Int. Volume	05:00 PM					04:45 PM					05:30 PM					3:45:00 PM					
Peak Factor	66	76	0	0	142	25	0	96	0	121	0	59	23	0	82						0.971
					0.968					0.888					0.777						



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: SHADOW MTN DR
E/W STREET: HWY 73
CITY: CONIFER
COUNTY: JEFFERSON

File Name : SHAD73PM2
Site Code : 00000020
Start Date : 8/24/2022
Page No : 1

Groups Printed- VEHICLES

Start Time	HWY 73 Southbound				NO ACCESS Westbound				HWY 73 Northbound				SHADOW MTN DR Eastbound				Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
04:00 PM	0	101	4	0	0	0	0	0	30	85	0	0	7	0	20	0	247
04:15 PM	0	98	6	0	0	0	0	0	44	77	0	1	4	0	27	0	257
04:30 PM	0	95	6	0	0	0	0	0	40	82	0	0	7	0	19	0	249
04:45 PM	0	101	6	0	0	0	0	0	56	73	0	0	6	0	25	0	267
Total	0	395	22	0	0	0	0	0	170	317	0	1	24	0	91	0	1020
05:00 PM	0	121	4	0	0	0	0	0	32	89	1	0	1	0	23	0	271
05:15 PM	0	104	5	0	0	0	0	0	45	68	0	0	1	0	30	0	253
05:30 PM	0	107	1	0	0	0	0	0	50	80	0	0	0	0	22	0	260
05:45 PM	0	101	7	0	0	0	0	0	43	91	0	0	1	0	24	0	267
Total	0	433	17	0	0	0	0	0	170	328	1	0	3	0	99	0	1051
Grand Total	0	828	39	0	0	0	0	0	340	645	1	1	27	0	190	0	2071
Apprch %	0.0	95.5	4.5	0.0	0.0	0.0	0.0	0.0	34.4	65.3	0.1	0.1	12.4	0.0	87.6	0.0	
Total %	0.0	40.0	1.9	0.0	0.0	0.0	0.0	0.0	16.4	31.1	0.0	0.0	1.3	0.0	9.2	0.0	

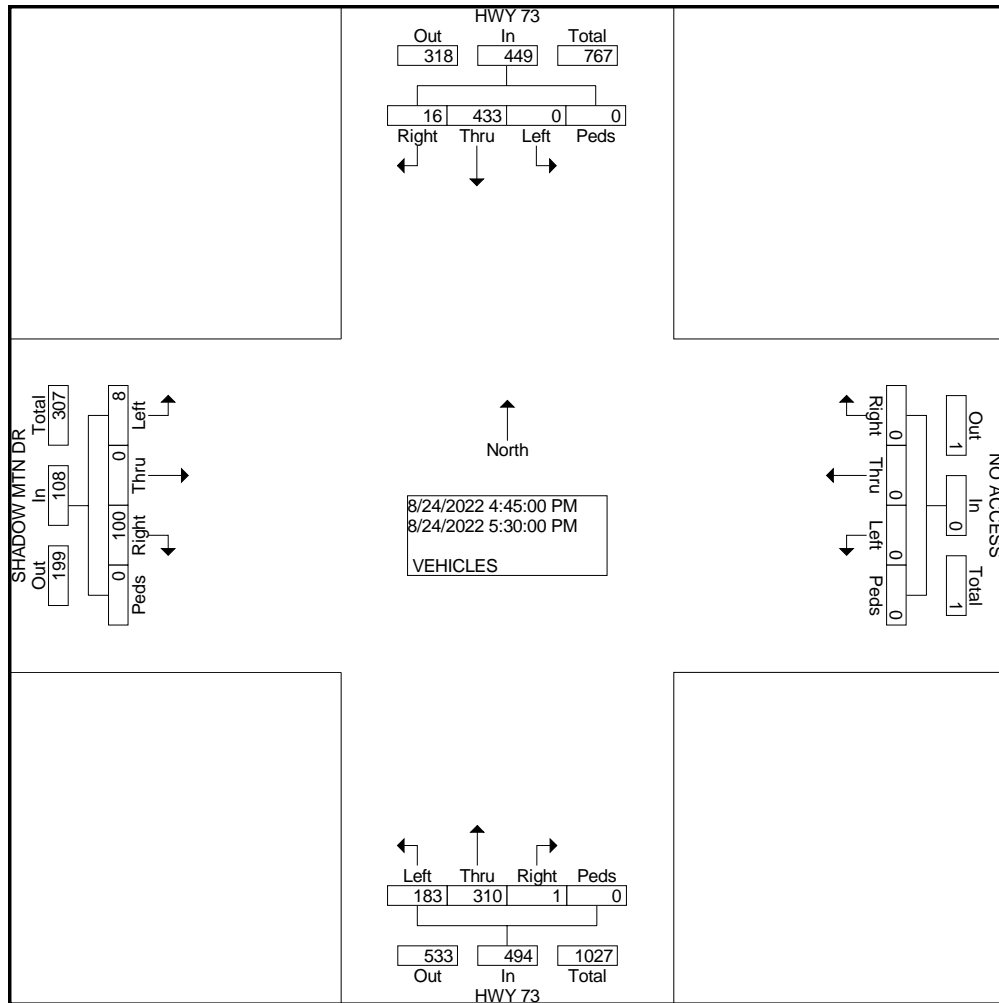
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: SHADOW MTN DR
E/W STREET: HWY 73
CITY: CONIFER
COUNTY: JEFFERSON

File Name : SHAD73PM2
Site Code : 00000020
Start Date : 8/24/2022
Page No : 2

Start Time	HWY 73 Southbound					NO ACCESS Westbound					HWY 73 Northbound					SHADOW MTN DR Eastbound					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:45 PM																				
Volume	0	433	16	0	449	0	0	0	0	0	183	310	1	0	494	8	0	100	0	108	1051
Percent	0.0	96.4	3.6	0.0		0.0	0.0	0.0	0.0		37.0	62.8	0.2	0.0		7.4	0.0	92.6	0.0		
05:00 Volume	0	121	4	0	125	0	0	0	0	0	32	89	1	0	122	1	0	23	0	24	271
Peak Factor	0.970																				
High Int. Volume	05:00 PM					3:45:00 PM					05:30 PM					04:45 PM					
Peak Factor	0	121	4	0	125	0	0	0	0	0	50	80	0	0	130	6	0	25	0	31	0.871



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK0827
Site Code : 00000013
Start Date : 8/27/2022
Page No : 1

Groups Printed- VEHICLES

Start Time	HWY 73 Southbound			BARKLEY RD Westbound			HWY 73 Northbound			NO ACCESS Eastbound			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
08:00 AM	41	22	0	5	0	28	0	24	2	0	0	0	122
08:15 AM	40	26	0	5	0	30	0	37	3	0	0	0	141
08:30 AM	30	36	0	19	1	42	0	30	9	0	0	0	167
08:45 AM	63	35	0	14	1	36	0	39	16	0	0	0	204
Total	174	119	0	43	2	136	0	130	30	0	0	0	634
09:00 AM	44	25	0	8	0	34	0	31	7	0	0	0	149
09:15 AM	62	41	0	31	0	55	0	45	4	0	0	0	238
09:30 AM	55	48	0	24	1	53	0	54	10	0	0	0	245
09:45 AM	62	64	0	46	4	51	0	52	6	0	0	0	285
Total	223	178	0	109	5	193	0	182	27	0	0	0	917
12:00 PM	67	44	0	21	0	58	0	63	17	0	0	0	270
12:15 PM	71	44	0	15	0	75	0	54	7	0	0	0	266
12:30 PM	241	52	0	5	0	56	0	48	25	0	0	0	427
12:45 PM	88	48	0	17	0	82	0	66	39	0	0	0	340
Total	467	188	0	58	0	271	0	231	88	0	0	0	1303
01:00 PM	70	60	0	18	1	59	0	43	18	0	0	0	269
01:15 PM	63	60	0	4	0	70	0	51	10	0	0	0	258
01:30 PM	75	43	0	7	0	73	0	52	12	0	0	0	262
01:45 PM	74	52	0	17	0	165	0	49	10	0	0	0	367
Total	282	215	0	46	1	367	0	195	50	0	0	0	1156
Grand Total	1146	700	0	256	8	967	0	738	195	0	0	0	4010
Apprch %	62.1	37.9	0.0	20.8	0.6	78.6	0.0	79.1	20.9	0.0	0.0	0.0	
Total %	28.6	17.5	0.0	6.4	0.2	24.1	0.0	18.4	4.9	0.0	0.0	0.0	

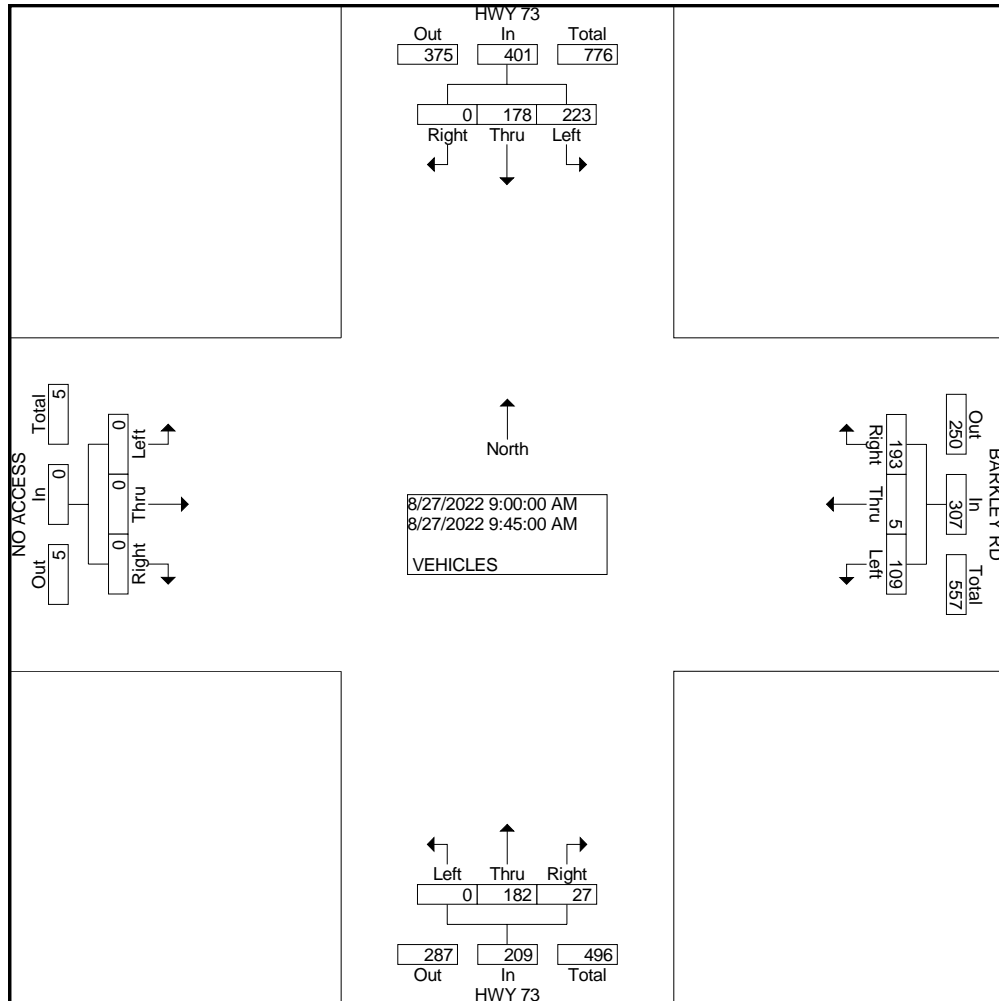
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK0827
Site Code : 00000013
Start Date : 8/27/2022
Page No : 2

Start Time	HWY 73 Southbound				BARKLEY RD Westbound				HWY 73 Northbound				NO ACCESS Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 08:00 AM to 09:45 AM - Peak 1 of 1																	
Intersection	09:00 AM																
Volume	223	178	0	401	109	5	193	307	0	182	27	209	0	0	0	0	917
Percent	55.6	44.4	0.0		35.5	1.6	62.9		0.0	87.1	12.9		0.0	0.0	0.0		
Volume	09:45																
Volume	62	64	0	126	46	4	51	101	0	52	6	58	0	0	0	0	285
Peak Factor	0.804																
High Int.	09:45 AM																
Volume	62	64	0	126	46	4	51	101	0	54	10	64	7:45:00 AM				
Peak Factor	0.796								0.760								



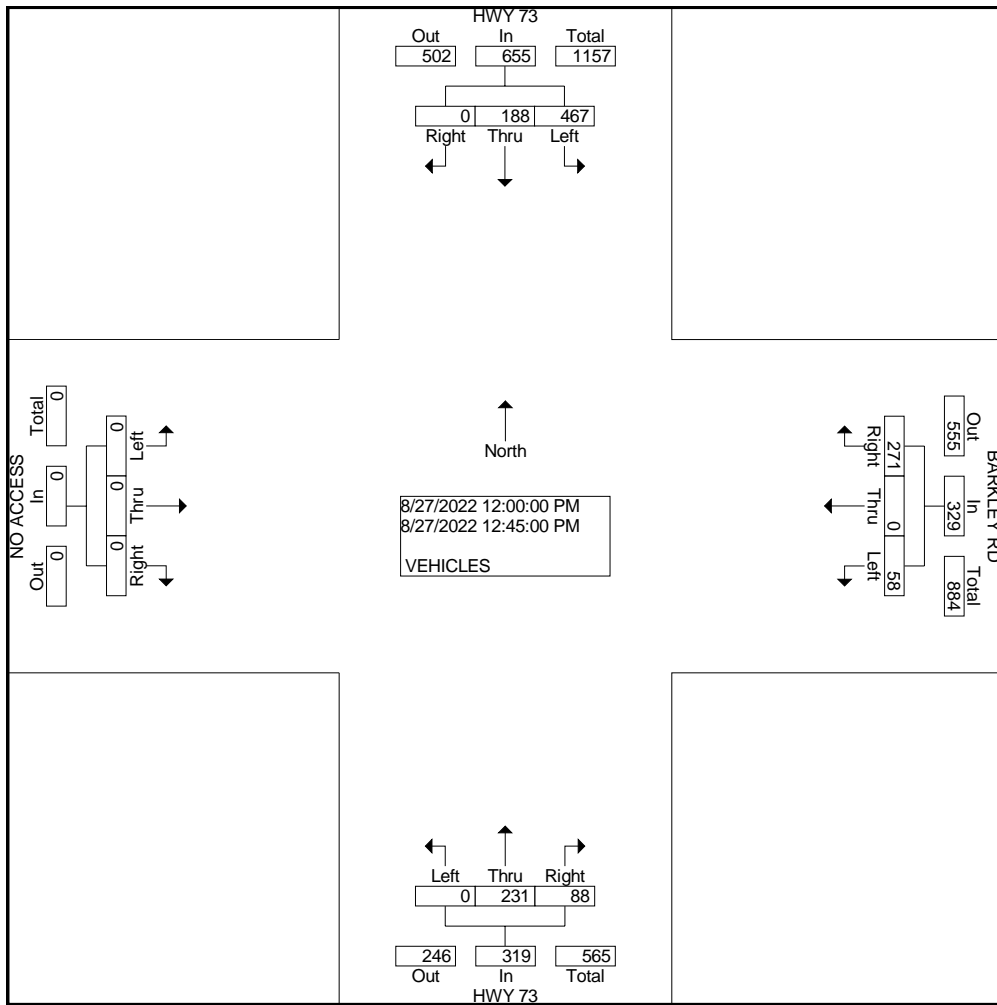
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK0827
Site Code : 00000013
Start Date : 8/27/2022
Page No : 3

Start Time	HWY 73 Southbound				BARKLEY RD Westbound				HWY 73 Northbound				NO ACCESS Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 12:00 PM to 01:45 PM - Peak 1 of 1																	
Intersection	12:00 PM																
Volume	467	188	0	655	58	0	271	329	0	231	88	319	0	0	0	0	1303
Percent	71.3	28.7	0.0		17.6	0.0	82.4		0.0	72.4	27.6		0.0	0.0	0.0		
12:30 Volume	241	52	0	293	5	0	56	61	0	48	25	73	0	0	0	0	427
Peak Factor	0.763																
High Int.	12:30 PM																
Volume	241	52	0	293	17	0	82	99	0	66	39	105					
Peak Factor	0.559				0.831				0.760								



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK0828
Site Code : 00000013
Start Date : 8/28/2022
Page No : 1

Groups Printed- VEHICLES

Start Time	HWY 73 Southbound			BARKLEY RD Westbound			HWY 73 Northbound			NO ACCESS Eastbound			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
08:00 AM	37	18	0	0	0	25	0	19	4	0	0	0	103
08:15 AM	31	14	0	3	0	22	0	23	1	0	0	0	94
08:30 AM	31	25	0	1	0	29	0	26	6	0	0	0	118
08:45 AM	38	34	0	0	0	26	0	35	12	0	0	0	145
Total	137	91	0	4	0	102	0	103	23	0	0	0	460
09:00 AM	33	27	0	1	0	28	0	27	4	0	0	0	120
09:15 AM	74	23	0	1	0	36	0	36	4	0	0	0	174
09:30 AM	47	27	0	4	0	29	0	61	6	0	0	0	174
09:45 AM	54	38	0	6	0	44	0	63	4	0	0	0	209
Total	208	115	0	12	0	137	0	187	18	0	0	0	677
12:00 PM	52	59	0	12	0	62	0	48	10	0	0	0	243
12:15 PM	63	58	0	6	0	38	0	58	10	0	0	0	233
12:30 PM	53	51	0	7	0	59	0	57	10	0	0	0	237
12:45 PM	54	43	0	8	0	76	0	57	16	0	0	0	254
Total	222	211	0	33	0	235	0	220	46	0	0	0	967
01:00 PM	79	46	0	5	0	60	0	65	6	0	0	0	261
01:15 PM	56	53	0	4	1	53	0	56	17	0	0	0	240
01:30 PM	45	45	0	5	1	57	0	51	10	0	0	0	214
01:45 PM	52	41	0	0	0	52	0	45	12	0	0	0	202
Total	232	185	0	14	2	222	0	217	45	0	0	0	917
Grand Total	799	602	0	63	2	696	0	727	132	0	0	0	3021
Apprch %	57.0	43.0	0.0	8.3	0.3	91.5	0.0	84.6	15.4	0.0	0.0	0.0	
Total %	26.4	19.9	0.0	2.1	0.1	23.0	0.0	24.1	4.4	0.0	0.0	0.0	

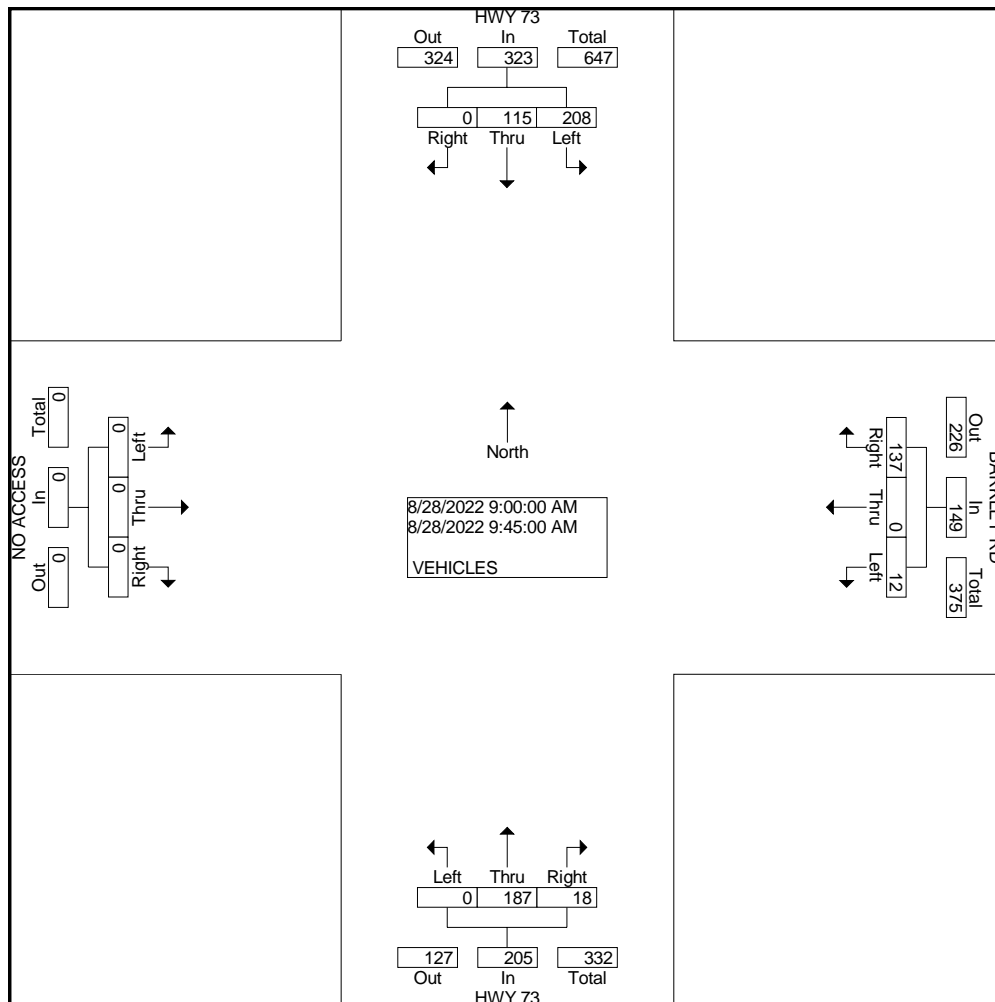
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK0828
Site Code : 00000013
Start Date : 8/28/2022
Page No : 2

Start Time	HWY 73 Southbound				BARKLEY RD Westbound				HWY 73 Northbound				NO ACCESS Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 08:00 AM to 09:45 AM - Peak 1 of 1																	
Intersection	09:00 AM																
Volume	208	115	0	323	12	0	137	149	0	187	18	205	0	0	0	0	677
Percent	64.4	35.6	0.0		8.1	0.0	91.9		0.0	91.2	8.8		0.0	0.0	0.0		
09:45	Volume																
Volume	54	38	0	92	6	0	44	50	0	63	4	67	0	0	0	0	209
Peak Factor	0.810																
High Int.	09:15 AM				09:45 AM				09:30 AM				7:45:00 AM				
Volume	74	23	0	97	6	0	44	50	0	61	6	67					
Peak Factor	0.832				0.745				0.765								



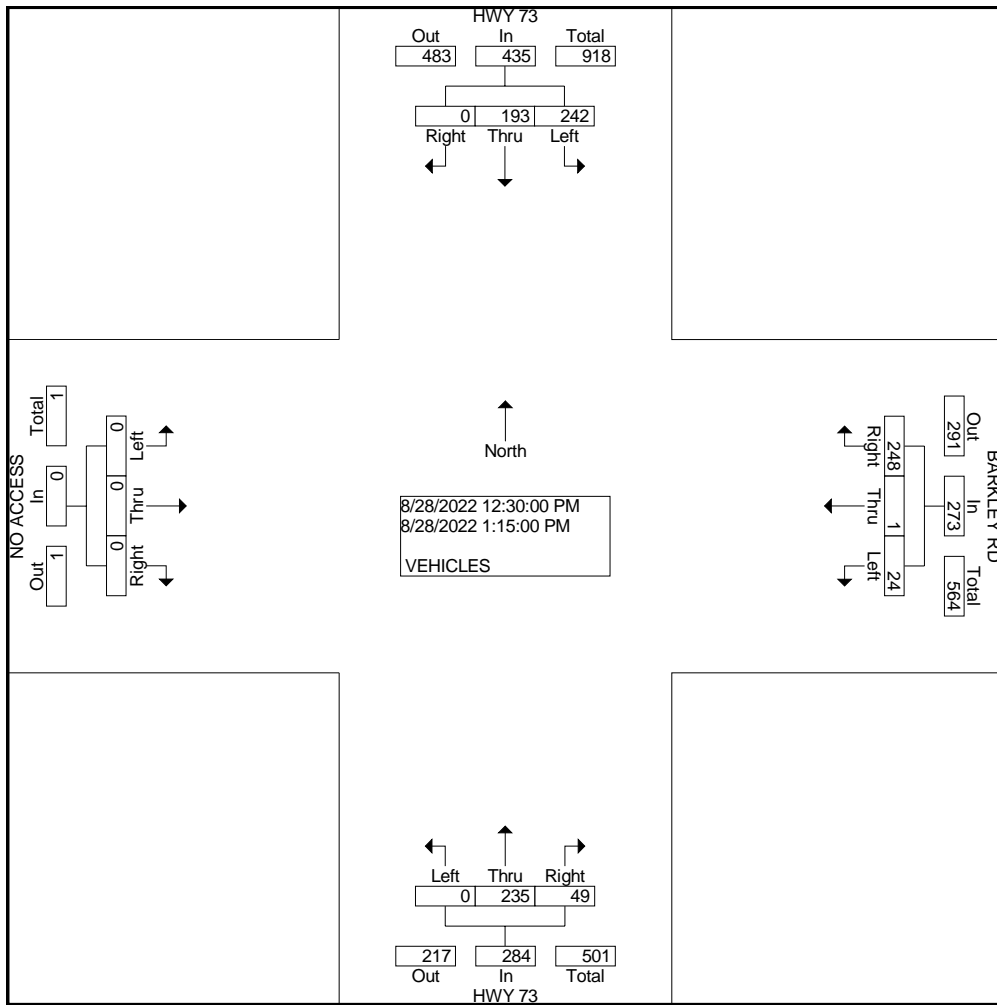
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: BARKLEY RD
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73BARK0828
Site Code : 00000013
Start Date : 8/28/2022
Page No : 3

Start Time	HWY 73 Southbound				BARKLEY RD Westbound				HWY 73 Northbound				NO ACCESS Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 12:00 PM to 01:45 PM - Peak 1 of 1																	
Intersection	12:30 PM																
Volume	242	193	0	435	24	1	248	273	0	235	49	284	0	0	0	0	992
Percent	55.6	44.4	0.0		8.8	0.4	90.8		0.0	82.7	17.3		0.0	0.0	0.0		
01:00																	
Volume	79	46	0	125	5	0	60	65	0	65	6	71	0	0	0	0	261
Peak Factor	0.950																
High Int.	01:00 PM																
Volume	79	46	0	125	8	0	76	84	0	57	16	73					
Peak Factor	0.870				0.813				0.973								



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: SHADOW MOUNTAIN DR
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73SHADOW 0827
Site Code : 00000011
Start Date : 8/27/2022
Page No : 1

Groups Printed- VEHICLES

Start Time	HWY 73 Southbound			NO ACCESS Westbound			HWY 73 Northbound			SHADOW MTN DR Eastbound			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
08:00 AM	0	37	1	0	0	0	10	40	0	6	0	20	114
08:15 AM	0	44	1	0	0	0	16	55	0	3	0	22	141
08:30 AM	0	43	2	0	0	0	16	60	0	6	0	32	159
08:45 AM	0	68	2	0	0	0	21	50	0	6	0	22	169
Total	0	192	6	0	0	0	63	205	0	21	0	96	583
09:00 AM	0	39	1	0	1	0	14	47	0	1	0	29	132
09:15 AM	0	71	4	0	0	0	23	81	0	5	0	30	214
09:30 AM	0	75	2	0	0	0	24	94	0	1	0	29	225
09:45 AM	0	84	2	0	0	0	26	72	0	5	0	32	221
Total	0	269	9	0	1	0	87	294	0	12	0	120	792
12:00 PM	0	78	3	0	0	0	30	89	0	6	0	29	235
12:15 PM	0	72	3	0	0	0	38	89	0	2	0	29	233
12:30 PM	0	218	3	0	0	0	31	83	0	6	0	24	365
12:45 PM	0	81	6	0	0	0	35	115	0	8	0	41	286
Total	0	449	15	0	0	0	134	376	0	22	0	123	1119
01:00 PM	0	99	4	0	0	0	33	71	0	5	0	34	246
01:15 PM	0	82	5	0	0	0	38	94	0	6	0	30	255
01:30 PM	0	89	7	0	0	0	30	88	0	4	0	32	250
01:45 PM	0	95	2	0	0	0	32	176	0	4	0	25	334
Total	0	365	18	0	0	0	133	429	0	19	0	121	1085
Grand Total	0	1275	48	0	1	0	417	1304	0	74	0	460	3579
Apprch %	0.0	96.4	3.6	0.0	100.0	0.0	24.2	75.8	0.0	13.9	0.0	86.1	
Total %	0.0	35.6	1.3	0.0	0.0	0.0	11.7	36.4	0.0	2.1	0.0	12.9	

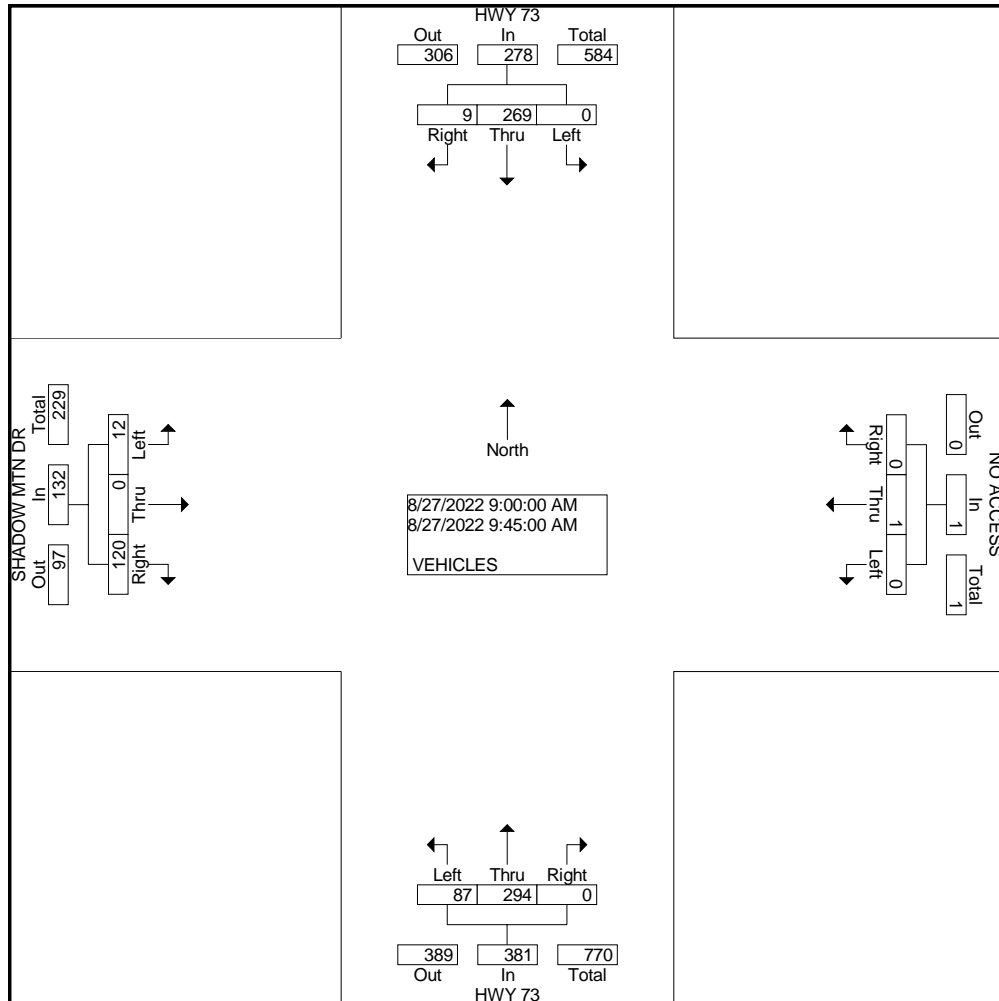
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: SHADOW MOUNTAIN DR
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73SHADOW 0827
Site Code : 00000011
Start Date : 8/27/2022
Page No : 2

Start Time	HWY 73 Southbound				NO ACCESS Westbound				HWY 73 Northbound				SHADOW MTN DR Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 09:00 AM to 09:45 AM - Peak 1 of 1																	
Intersection	09:00 AM																
Volume	0	269	9	278	0	1	0	1	87	294	0	381	12	0	120	132	792
Percent	0.0	96.8	3.2		0.0	100.0	0.0		22.8	77.2	0.0		9.1	0.0	90.9		
09:30 Volume	0	75	2	77	0	0	0	0	24	94	0	118	1	0	29	30	225
Peak Factor	0.880																
High Int.	09:45 AM																
Volume	0	84	2	86	0	1	0	1	24	94	0	118	5	0	32	37	
Peak Factor	0.808																
					0.250								0.807				



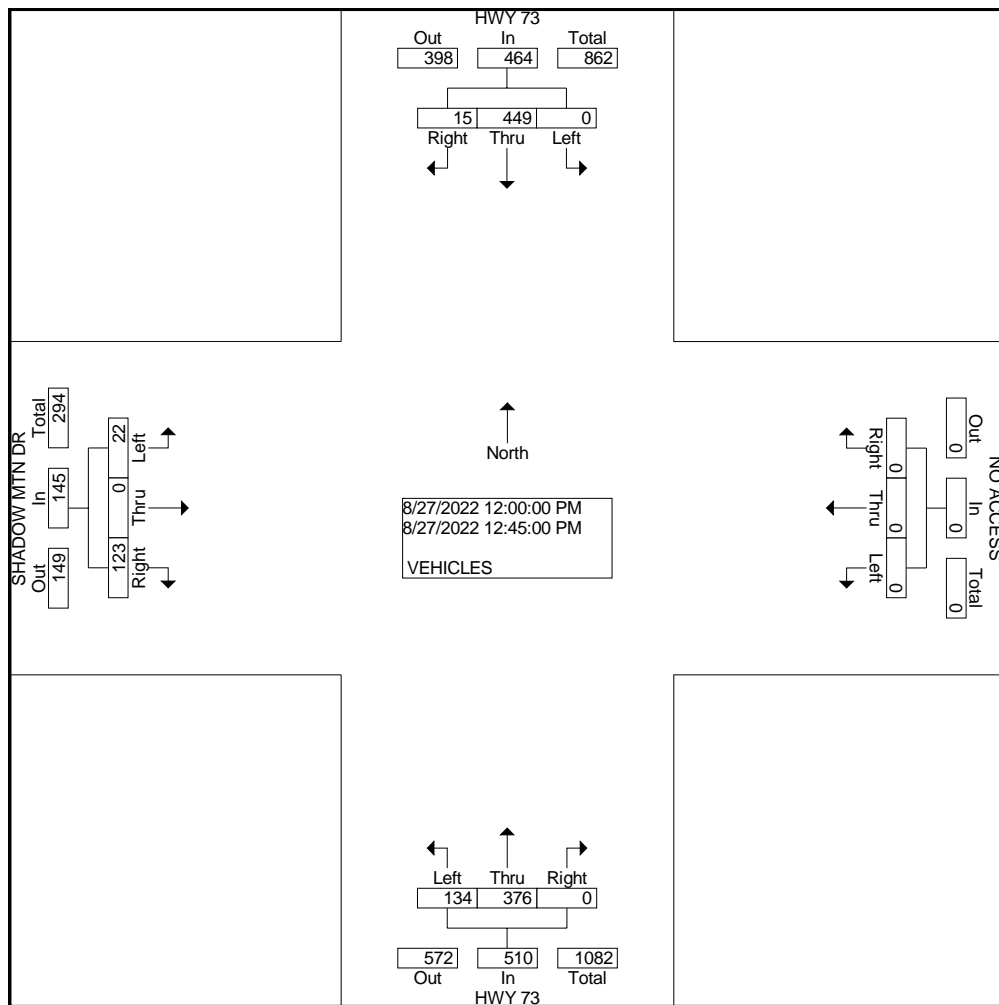
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: SHADOW MOUNTAIN DR
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73SHADOW 0827
Site Code : 00000011
Start Date : 8/27/2022
Page No : 3

Start Time	HWY 73 Southbound				NO ACCESS Westbound				HWY 73 Northbound				SHADOW MTN DR Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 12:00 PM to 12:45 PM - Peak 1 of 1																	
Intersection	12:00 PM																
Volume	0	449	15	464	0	0	0	0	134	376	0	510	22	0	123	145	1119
Percent	0.0	96.8	3.2		0.0	0.0	0.0		26.3	73.7	0.0		15.2	0.0	84.8		
12:30																	
Volume	0	218	3	221	0	0	0	0	31	83	0	114	6	0	24	30	365
Peak Factor	0.766																
High Int.	12:30 PM																
Volume	0	218	3	221	0	0	0	0	35	115	0	150	8	0	41	49	
Peak Factor	0.525								0.850				0.740				



COUNTER MEASURES INC.

1889 YORK STREET
DENVER.COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: SHADOW MOUNTAIN DR
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73SHADOW0828
Site Code : 00000112
Start Date : 8/28/2022
Page No : 1

Groups Printed- VEHICLES

Start Time	HWY 73 Southbound			NO ACCESS Westbound			HWY 73 Northbound			SHADOW MTN DR Eastbound			Int. Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
08:00 AM	0	34	0	0	0	0	10	33	0	1	0	16	94
08:15 AM	0	32	2	0	0	0	11	34	0	1	0	16	96
08:30 AM	0	44	2	0	0	0	10	44	0	1	0	15	116
08:45 AM	0	56	2	0	0	0	11	52	0	2	0	17	140
Total	0	166	6	0	0	0	42	163	0	5	0	64	446
09:00 AM	0	41	5	0	0	0	9	41	0	2	0	19	117
09:15 AM	0	68	2	0	0	0	23	53	0	5	0	28	179
09:30 AM	0	48	0	0	0	0	13	78	0	7	0	35	181
09:45 AM	0	61	4	0	0	0	15	81	0	10	0	30	201
Total	0	218	11	0	0	0	60	253	0	24	0	112	678
12:00 PM	0	83	3	0	0	0	18	88	0	2	0	23	217
12:15 PM	0	92	3	0	0	0	32	69	0	3	0	23	222
12:30 PM	0	71	1	0	1	0	32	85	0	1	0	27	218
12:45 PM	0	81	7	0	0	0	33	97	0	1	0	24	243
Total	0	327	14	0	1	0	115	339	0	7	0	97	900
01:00 PM	0	87	6	0	0	0	39	84	0	4	0	32	252
01:15 PM	0	76	4	0	0	0	27	88	0	6	0	25	226
01:30 PM	0	71	4	0	0	0	32	77	0	4	0	17	205
01:45 PM	0	74	6	0	0	0	26	72	0	5	0	21	204
Total	0	308	20	0	0	0	124	321	0	19	0	95	887
Grand Total	0	1019	51	0	1	0	341	1076	0	55	0	368	2911
Apprch %	0.0	95.2	4.8	0.0	100.0	0.0	24.1	75.9	0.0	13.0	0.0	87.0	
Total %	0.0	35.0	1.8	0.0	0.0	0.0	11.7	37.0	0.0	1.9	0.0	12.6	

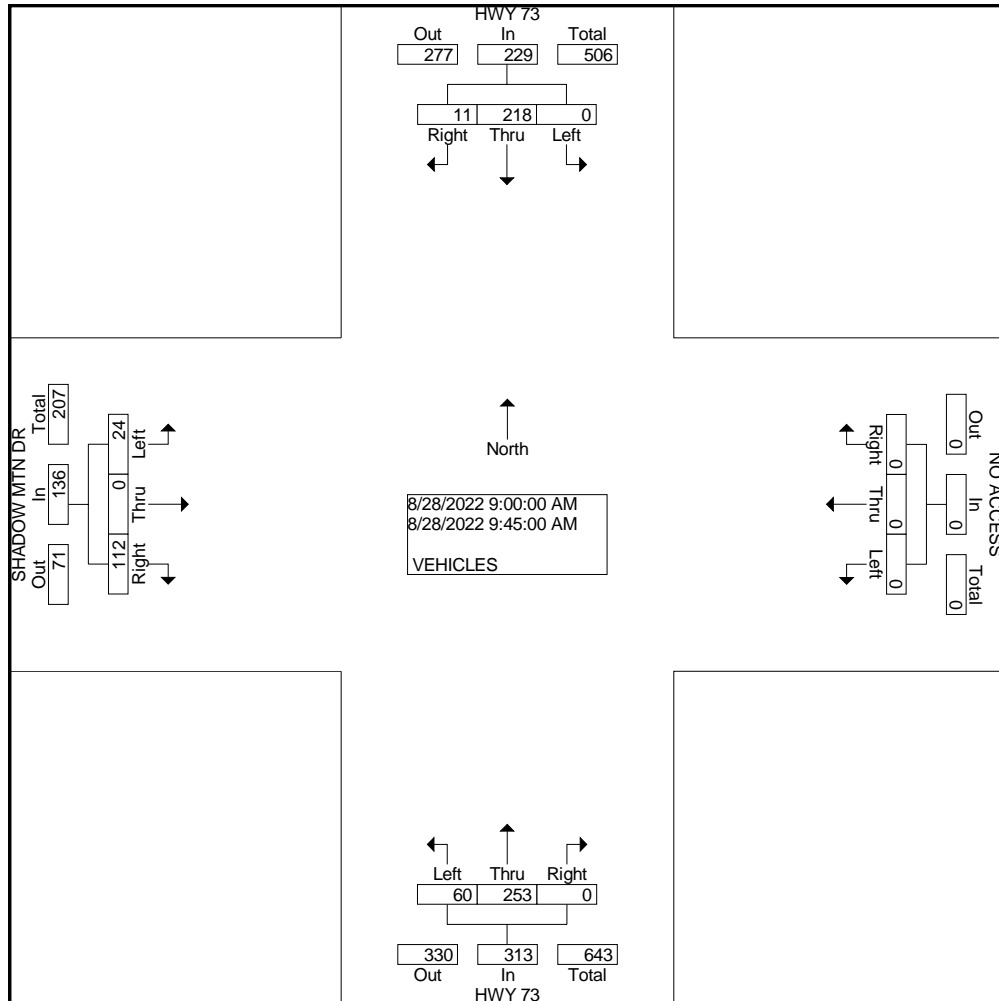
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: SHADOW MOUNTAIN DR
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73SHADOW0828
Site Code : 00000112
Start Date : 8/28/2022
Page No : 2

Start Time	HWY 73 Southbound				NO ACCESS Westbound				HWY 73 Northbound				SHADOW MTN DR Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 09:00 AM to 09:45 AM - Peak 1 of 1																	
Intersection	09:00 AM																
Volume	0	218	11	229	0	0	0	0	60	253	0	313	24	0	112	136	678
Percent	0.0	95.2	4.8		0.0	0.0	0.0		19.2	80.8	0.0		17.6	0.0	82.4		
09:45	09:45 AM																
Volume	0	61	4	65	0	0	0	0	15	81	0	96	10	0	30	40	201
Peak Factor	0.843																
High Int.	09:15 AM																
Volume	0	68	2	70	0	0	0	0	15	81	0	96	7	0	35	42	
Peak Factor	0.818								0.815				0.810				



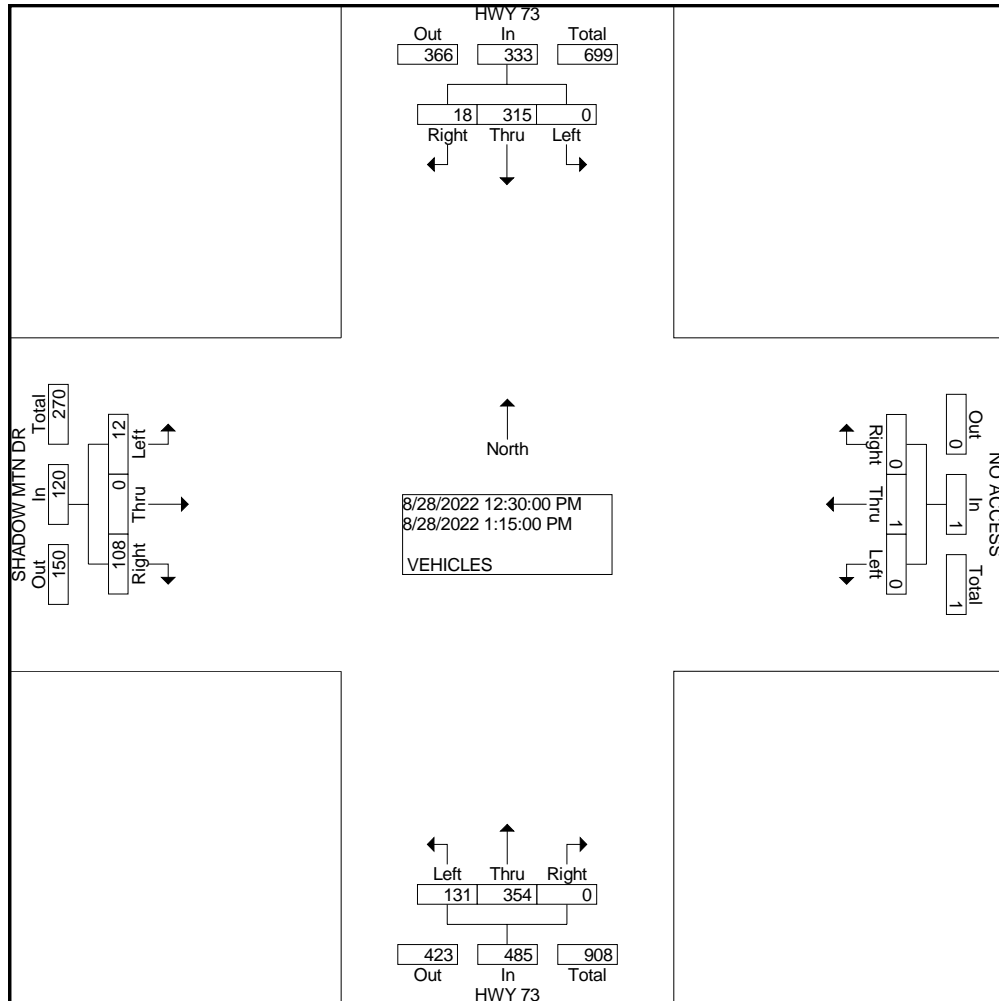
COUNTER MEASURES INC.

1889 YORK STREET
DENVER, COLORADO
303-333-7409

N/S STREET: HWY 73
E/W STREET: SHADOW MOUNTAIN DR
CITY: CONIFER
COUNTY: JEFFERSON

File Name : HWY73SHADOW0828
Site Code : 00000112
Start Date : 8/28/2022
Page No : 3

Start Time	HWY 73 Southbound				NO ACCESS Westbound				HWY 73 Northbound				SHADOW MTN DR Eastbound				Int. Total
	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	
Peak Hour From 12:30 PM to 01:15 PM - Peak 1 of 1																	
Intersection	12:30 PM																
Volume	0	315	18	333	0	1	0	1	131	354	0	485	12	0	108	120	939
Percent	0.0	94.6	5.4		0.0	100.0	0.0		27.0	73.0	0.0		10.0	0.0	90.0		
01:00 Volume	0	87	6	93	0	0	0	0	39	84	0	123	4	0	32	36	252
Peak Factor	0.932																
High Int.	01:00 PM				12:30 PM				12:45 PM				01:00 PM				
Volume	0	87	6	93	0	1	0	1	33	97	0	130	4	0	32	36	
Peak Factor	0.895				0.250				0.933				0.833				



COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: HWY 73 N-O BARKLEY RD
 City: CONIFER
 County: JEFFERSON
 Direction: NORTH/SOUTH

Site Code: 222208
 Station ID: 222208

Start Time	23-Aug-22 Tue	NORTH	SOUTH							Total
12:00 AM		10	10							20
01:00		6	6							12
02:00		6	1							7
03:00		5	5							10
04:00		40	12							52
05:00		88	42							130
06:00		237	118							355
07:00		552	389							941
08:00		391	371							762
09:00		375	304							679
10:00		390	273							663
11:00		445	312							757
12:00 PM		441	278							719
01:00		503	244							747
02:00		547	298							845
03:00		599	356							955
04:00		581	359							940
05:00		549	424							973
06:00		365	335							700
07:00		244	239							483
08:00		148	206							354
09:00		73	97							170
10:00		15	51							66
11:00		16	36							52
Total		6626	4766							11392
Percent		58.2%	41.8%							
AM Peak	-	07:00	07:00	-	-	-	-	-	-	07:00
Vol.	-	552	389	-	-	-	-	-	-	941
PM Peak	-	15:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	599	424	-	-	-	-	-	-	973

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: HWY 73 N-O BARKLEY RD
 City: CONIFER
 County: JEFFERSON
 Direction: NORTH/SOUTH

Site Code: 222208
 Station ID: 222208

Start Time	24-Aug-22 Wed	NORTH	SOUTH							Total
12:00 AM		9	12							21
01:00		5	6							11
02:00		2	6							8
03:00		6	10							16
04:00		30	15							45
05:00		94	43							137
06:00		227	139							366
07:00		489	356							845
08:00		453	398							851
09:00		407	317							724
10:00		400	224							624
11:00		461	275							736
12:00 PM		440	332							772
01:00		395	311							706
02:00		442	420							862
03:00		557	399							956
04:00		555	412							967
05:00		556	451							1007
06:00		314	341							655
07:00		176	271							447
08:00		147	175							322
09:00		87	101							188
10:00		28	49							77
11:00		15	20							35
Total		6295	5083							11378
Percent		55.3%	44.7%							
AM Peak	-	07:00	08:00	-	-	-	-	-	-	08:00
Vol.	-	489	398	-	-	-	-	-	-	851
PM Peak	-	15:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	557	451	-	-	-	-	-	-	1007

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: HWY 73 N-O BARKLEY RD
 City: CONIFER
 County: JEFFERSON
 Direction: NORTH/SOUTH

Site Code: 222208
 Station ID: 222208

Start Time	25-Aug-22 Thu	NORTH	SOUTH							Total
12:00 AM		8	11							19
01:00		5	6							11
02:00		8	6							14
03:00		12	4							16
04:00		24	19							43
05:00		93	42							135
06:00		233	127							360
07:00		561	375							936
08:00		387	370							757
09:00		445	341							786
10:00		393	261							654
11:00		420	328							748
12:00 PM		452	367							819
01:00		397	338							735
02:00		429	425							854
03:00		532	446							978
04:00		421	431							852
05:00		449	475							924
06:00		278	300							578
07:00		186	223							409
08:00		126	144							270
09:00		68	94							162
10:00		36	46							82
11:00		18	46							64
Total		5981	5225							11206
Percent		53.4%	46.6%							
AM Peak	-	07:00	07:00	-	-	-	-	-	-	07:00
Vol.	-	561	375	-	-	-	-	-	-	936
PM Peak	-	15:00	17:00	-	-	-	-	-	-	15:00
Vol.	-	532	475	-	-	-	-	-	-	978

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: HWY 73 N-O BARKLEY RD
 City: CONIFER
 County: JEFFERSON
 Direction: NORTH/SOUTH

Site Code: 222208
 Station ID: 222208

Start Time	28-Aug-22 Sun	NORTH	SOUTH							Total
12:00 AM		22	30							52
01:00		18	4							22
02:00		11	5							16
03:00		7	3							10
04:00		10	13							23
05:00		27	16							43
06:00		62	40							102
07:00		139	113							252
08:00		238	199							437
09:00		335	312							647
10:00		418	346							764
11:00		481	360							841
12:00 PM		469	395							864
01:00		437	424							861
02:00		41	39							80
03:00		*	*							*
04:00		*	*							*
05:00		*	*							*
06:00		*	*							*
07:00		*	*							*
08:00		*	*							*
09:00		*	*							*
10:00		*	*							*
11:00		*	*							*
Total		2715	2299							5014
Percent		54.1%	45.9%							
AM Peak	-	11:00	11:00	-	-	-	-	-	-	11:00
Vol.	-	481	360	-	-	-	-	-	-	841
PM Peak	-	12:00	13:00	-	-	-	-	-	-	12:00
Vol.	-	469	424	-	-	-	-	-	-	864
Grand Total		36126	29763							65889
Percent		54.8%	45.2%							
ADT		ADT 9,827	AADT 9,827							

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	22-Aug-22 Mon	EAST	WEST	Total
12:00 AM		*	*	*
01:00		*	*	*
02:00		*	*	*
03:00		*	*	*
04:00		*	*	*
05:00		*	*	*
06:00		*	*	*
07:00		*	*	*
08:00		*	*	*
09:00		*	*	*
10:00		*	*	*
11:00		*	*	*
12:00 PM		61	76	137
01:00		82	78	160
02:00		61	73	134
03:00		92	110	202
04:00		85	108	193
05:00		62	125	187
06:00		48	116	164
07:00		18	60	78
08:00		11	51	62
09:00		6	30	36
10:00		4	11	15
11:00		2	17	19
Total		532	855	1387
Percent		38.4%	61.6%	
AM Peak	-	-	-	-
Vol.	-	-	-	-
PM Peak	-	15:00	17:00	15:00
Vol.	-	92	125	202

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	23-Aug-22 Tue	EAST	WEST							Total
12:00 AM		1	3							4
01:00		2	0							2
02:00		1	1							2
03:00		3	0							3
04:00		22	0							22
05:00		38	0							38
06:00		100	8							108
07:00		150	53							203
08:00		123	49							172
09:00		65	63							128
10:00		82	64							146
11:00		77	73							150
12:00 PM		84	79							163
01:00		70	72							142
02:00		79	86							165
03:00		97	104							201
04:00		78	113							191
05:00		82	132							214
06:00		43	110							153
07:00		25	69							94
08:00		20	54							74
09:00		4	30							34
10:00		2	23							25
11:00		4	15							19
Total		1252	1201							2453
Percent		51.0%	49.0%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	07:00
Vol.	-	150	73	-	-	-	-	-	-	203
PM Peak	-	15:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	97	132	-	-	-	-	-	-	214

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	24-Aug-22 Wed	EAST	WEST							Total
12:00 AM		1	8							9
01:00		2	1							3
02:00		0	2							2
03:00		3	1							4
04:00		21	1							22
05:00		38	2							40
06:00		79	15							94
07:00		151	55							206
08:00		133	59							192
09:00		80	67							147
10:00		77	43							120
11:00		92	65							157
12:00 PM		80	76							156
01:00		78	82							160
02:00		82	83							165
03:00		117	118							235
04:00		99	124							223
05:00		74	112							186
06:00		45	123							168
07:00		24	86							110
08:00		12	54							66
09:00		4	27							31
10:00		3	19							22
11:00		1	6							7
Total		1296	1229							2525
Percent		51.3%	48.7%							
AM Peak	-	07:00	09:00	-	-	-	-	-	-	07:00
Vol.	-	151	67	-	-	-	-	-	-	206
PM Peak	-	15:00	16:00	-	-	-	-	-	-	15:00
Vol.	-	117	124	-	-	-	-	-	-	235

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	25-Aug-22 Thu	EAST	WEST							Total
12:00 AM		1	8							9
01:00		0	4							4
02:00		1	1							2
03:00		1	0							1
04:00		16	1							17
05:00		38	1							39
06:00		88	8							96
07:00		149	47							196
08:00		141	66							207
09:00		97	62							159
10:00		82	54							136
11:00		67	76							143
12:00 PM		71	86							157
01:00		84	72							156
02:00		89	62							151
03:00		74	108							182
04:00		90	114							204
05:00		57	136							193
06:00		38	88							126
07:00		17	64							81
08:00		12	53							65
09:00		8	33							41
10:00		4	18							22
11:00		1	15							16
Total		1226	1177							2403
Percent		51.0%	49.0%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	08:00
Vol.	-	149	76	-	-	-	-	-	-	207
PM Peak	-	16:00	17:00	-	-	-	-	-	-	16:00
Vol.	-	90	136	-	-	-	-	-	-	204

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	26-Aug-22 Fri	EAST	WEST							Total
12:00 AM		0	7							7
01:00		2	2							4
02:00		2	1							3
03:00		1	2							3
04:00		19	0							19
05:00		35	1							36
06:00		68	9							77
07:00		130	45							175
08:00		114	42							156
09:00		89	61							150
10:00		90	69							159
11:00		88	69							157
12:00 PM		86	89							175
01:00		74	64							138
02:00		68	72							140
03:00		76	95							171
04:00		89	111							200
05:00		80	116							196
06:00		54	92							146
07:00		32	76							108
08:00		14	46							60
09:00		8	32							40
10:00		10	20							30
11:00		2	12							14
Total		1231	1133							2364
Percent		52.1%	47.9%							
AM Peak	-	07:00	10:00	-	-	-	-	-	-	07:00
Vol.	-	130	69	-	-	-	-	-	-	175
PM Peak	-	16:00	17:00	-	-	-	-	-	-	16:00
Vol.	-	89	116	-	-	-	-	-	-	200

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	27-Aug-22 Sat	EAST	WEST							Total
12:00 AM		3	10							13
01:00		0	5							5
02:00		4	3							7
03:00		4	0							4
04:00		10	0							10
05:00		9	1							10
06:00		37	9							46
07:00		70	19							89
08:00		88	48							136
09:00		89	62							151
10:00		119	84							203
11:00		105	80							185
12:00 PM		104	99							203
01:00		100	105							205
02:00		80	104							184
03:00		92	104							196
04:00		76	77							153
05:00		73	68							141
06:00		51	66							117
07:00		53	54							107
08:00		27	43							70
09:00		10	29							39
10:00		9	18							27
11:00		3	20							23
Total		1216	1108							2324
Percent		52.3%	47.7%							
AM Peak	-	10:00	10:00	-	-	-	-	-	-	10:00
Vol.	-	119	84	-	-	-	-	-	-	203
PM Peak	-	12:00	13:00	-	-	-	-	-	-	13:00
Vol.	-	104	105	-	-	-	-	-	-	205

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O S. WARHAWK RD 1
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 22220
 Station ID: 22220

Start Time	28-Aug-22 Sun	EAST	WEST	Total						
12:00 AM		1	10	11						
01:00		3	4	7						
02:00		0	1	1						
03:00		1	1	2						
04:00		5	2	7						
05:00		11	1	12						
06:00		17	6	23						
07:00		46	17	63						
08:00		57	34	91						
09:00		107	49	156						
10:00		84	72	156						
11:00		96	88	184						
12:00 PM		100	76	176						
01:00		91	101	192						
02:00		52	41	93						
03:00		*	*	*						
04:00		*	*	*						
05:00		*	*	*						
06:00		*	*	*						
07:00		*	*	*						
08:00		*	*	*						
09:00		*	*	*						
10:00		*	*	*						
11:00		*	*	*						
Total		671	503	1174						
Percent		57.2%	42.8%							
AM Peak	-	09:00	11:00	-	-	-	-	-	-	11:00
Vol.	-	107	88	-	-	-	-	-	-	184
PM Peak	-	12:00	13:00	-	-	-	-	-	-	13:00
Vol.	-	100	101	-	-	-	-	-	-	192
Grand Total		7424	7206							14630
Percent		50.7%	49.3%							
ADT		ADT 2,137	AADT 2,137							

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	22-Aug-22 Mon	EAST	WEST	Total
12:00 AM		*	*	*
01:00		*	*	*
02:00		*	*	*
03:00		*	*	*
04:00		*	*	*
05:00		*	*	*
06:00		*	*	*
07:00		*	*	*
08:00		*	*	*
09:00		*	*	*
10:00		*	*	*
11:00		*	*	*
12:00 PM		*	*	*
01:00		92	93	185
02:00		74	77	151
03:00		105	120	225
04:00		91	113	204
05:00		82	122	204
06:00		57	129	186
07:00		22	71	93
08:00		18	51	69
09:00		18	25	43
10:00		5	11	16
11:00		2	16	18
Total		566	828	1394
Percent		40.6%	59.4%	
AM Peak	-	-	-	-
Vol.	-	-	-	-
PM Peak	-	15:00	18:00	15:00
Vol.	-	105	129	225

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	23-Aug-22 Tue	EAST	WEST							Total
12:00 AM		1	3							4
01:00		2	0							2
02:00		1	1							2
03:00		2	0							2
04:00		22	0							22
05:00		42	0							42
06:00		106	10							116
07:00		164	53							217
08:00		140	53							193
09:00		72	65							137
10:00		90	68							158
11:00		90	73							163
12:00 PM		87	86							173
01:00		76	78							154
02:00		82	88							170
03:00		111	118							229
04:00		95	120							215
05:00		94	143							237
06:00		43	120							163
07:00		35	74							109
08:00		20	66							86
09:00		6	38							44
10:00		3	19							22
11:00		4	14							18
Total		1388	1290							2678
Percent		51.8%	48.2%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	07:00
Vol.	-	164	73	-	-	-	-	-	-	217
PM Peak	-	15:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	111	143	-	-	-	-	-	-	237

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	24-Aug-22 Wed	EAST	WEST							Total
12:00 AM		8	3							11
01:00		2	1							3
02:00		0	2							2
03:00		3	1							4
04:00		18	0							18
05:00		45	2							47
06:00		85	17							102
07:00		158	55							213
08:00		148	65							213
09:00		82	68							150
10:00		86	48							134
11:00		93	77							170
12:00 PM		87	83							170
01:00		84	93							177
02:00		87	101							188
03:00		121	129							250
04:00		90	154							244
05:00		85	123							208
06:00		60	124							184
07:00		25	100							125
08:00		19	49							68
09:00		7	33							40
10:00		4	20							24
11:00		1	6							7
Total		1398	1354							2752
Percent		50.8%	49.2%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	07:00
Vol.	-	158	77	-	-	-	-	-	-	213
PM Peak	-	15:00	16:00	-	-	-	-	-	-	15:00
Vol.	-	121	154	-	-	-	-	-	-	250

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	25-Aug-22 Thu	EAST	WEST							Total
12:00 AM		3	8							11
01:00		0	4							4
02:00		1	1							2
03:00		2	1							3
04:00		16	0							16
05:00		39	2							41
06:00		88	12							100
07:00		161	54							215
08:00		162	68							230
09:00		103	71							174
10:00		85	57							142
11:00		74	83							157
12:00 PM		83	89							172
01:00		88	81							169
02:00		95	75							170
03:00		89	125							214
04:00		90	131							221
05:00		60	150							210
06:00		49	97							146
07:00		23	71							94
08:00		19	57							76
09:00		9	35							44
10:00		8	16							24
11:00		16	3							19
Total		1363	1291							2654
Percent		51.4%	48.6%							
AM Peak	-	08:00	11:00	-	-	-	-	-	-	08:00
Vol.	-	162	83	-	-	-	-	-	-	230
PM Peak	-	14:00	17:00	-	-	-	-	-	-	16:00
Vol.	-	95	150	-	-	-	-	-	-	221

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	26-Aug-22 Fri	EAST	WEST							Total
12:00 AM		0	7							7
01:00		2	2							4
02:00		2	2							4
03:00		1	2							3
04:00		19	0							19
05:00		39	1							40
06:00		72	9							81
07:00		138	47							185
08:00		135	48							183
09:00		100	66							166
10:00		106	76							182
11:00		87	82							169
12:00 PM		91	96							187
01:00		85	74							159
02:00		78	82							160
03:00		90	109							199
04:00		90	128							218
05:00		76	141							217
06:00		53	101							154
07:00		45	82							127
08:00		14	46							60
09:00		9	39							48
10:00		17	19							36
11:00		4	15							19
Total		1353	1274							2627
Percent		51.5%	48.5%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	07:00
Vol.	-	138	82	-	-	-	-	-	-	185
PM Peak	-	12:00	17:00	-	-	-	-	-	-	16:00
Vol.	-	91	141	-	-	-	-	-	-	218

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	27-Aug-22 Sat	EAST	WEST							Total
12:00 AM		2	10							12
01:00		9	0							9
02:00		8	0							8
03:00		4	0							4
04:00		10	0							10
05:00		10	1							11
06:00		39	9							48
07:00		71	21							92
08:00		92	54							146
09:00		101	65							166
10:00		132	90							222
11:00		111	93							204
12:00 PM		103	120							223
01:00		99	127							226
02:00		86	116							202
03:00		95	117							212
04:00		81	91							172
05:00		80	77							157
06:00		57	81							138
07:00		50	58							108
08:00		27	50							77
09:00		7	37							44
10:00		10	22							32
11:00		13	13							26
Total		1297	1252							2549
Percent		50.9%	49.1%							
AM Peak	-	10:00	11:00	-	-	-	-	-	-	10:00
Vol.	-	132	93	-	-	-	-	-	-	222
PM Peak	-	12:00	13:00	-	-	-	-	-	-	13:00
Vol.	-	103	127	-	-	-	-	-	-	226

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR E-O SHADOW BROOK DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222214
 Station ID: 222214

Start Time	28-Aug-22 Sun	EAST	WEST	Total						
12:00 AM		2	9	11						
01:00		3	4	7						
02:00		1	2	3						
03:00		1	1	2						
04:00		3	3	6						
05:00		15	1	16						
06:00		20	5	25						
07:00		46	17	63						
08:00		61	39	100						
09:00		113	56	169						
10:00		100	80	180						
11:00		109	89	198						
12:00 PM		92	104	196						
01:00		88	114	202						
02:00		38	37	75						
03:00		*	*	*						
04:00		*	*	*						
05:00		*	*	*						
06:00		*	*	*						
07:00		*	*	*						
08:00		*	*	*						
09:00		*	*	*						
10:00		*	*	*						
11:00		*	*	*						
Total		692	561	1253						
Percent		55.2%	44.8%							
AM Peak	-	09:00	11:00	-	-	-	-	-	-	11:00
Vol.	-	113	89	-	-	-	-	-	-	198
PM Peak	-	12:00	13:00	-	-	-	-	-	-	13:00
Vol.	-	92	114	-	-	-	-	-	-	202
Grand Total		8057	7850							15907
Percent		50.7%	49.3%							
ADT		ADT 2,351	AADT 2,351							

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	22-Aug-22 Mon	EAST	WEST	Total
12:00 AM		*	*	*
01:00		*	*	*
02:00		*	*	*
03:00		*	*	*
04:00		*	*	*
05:00		*	*	*
06:00		*	*	*
07:00		*	*	*
08:00		*	*	*
09:00		*	*	*
10:00		*	*	*
11:00		*	*	*
12:00 PM		*	*	*
01:00		84	138	222
02:00		95	100	195
03:00		129	138	267
04:00		109	152	261
05:00		122	130	252
06:00		142	86	228
07:00		78	32	110
08:00		65	18	83
09:00		38	7	45
10:00		13	7	20
11:00		17	2	19
Total		892	810	1702
Percent		52.4%	47.6%	
AM Peak	-	-	-	-
Vol.	-	-	-	-
PM Peak	-	18:00	16:00	15:00
Vol.	-	142	152	267

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	23-Aug-22 Tue	EAST	WEST							Total
12:00 AM		4	2							6
01:00		0	4							4
02:00		1	1							2
03:00		0	4							4
04:00		1	23							24
05:00		1	51							52
06:00		14	120							134
07:00		58	189							247
08:00		55	167							222
09:00		77	96							173
10:00		74	97							171
11:00		104	91							195
12:00 PM		100	103							203
01:00		104	72							176
02:00		117	87							204
03:00		158	104							262
04:00		147	110							257
05:00		169	118							287
06:00		123	92							215
07:00		92	36							128
08:00		81	22							103
09:00		34	17							51
10:00		24	3							27
11:00		18	4							22
Total		1556	1613							3169
Percent		49.1%	50.9%							
AM Peak	-	11:00	07:00	-	-	-	-	-	-	07:00
Vol.	-	104	189	-	-	-	-	-	-	247
PM Peak	-	17:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	169	118	-	-	-	-	-	-	287

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	24-Aug-22 Wed	EAST	WEST							Total
12:00 AM		7	5							12
01:00		1	3							4
02:00		2	0							2
03:00		1	4							5
04:00		0	20							20
05:00		3	52							55
06:00		21	99							120
07:00		61	183							244
08:00		70	180							250
09:00		76	104							180
10:00		57	101							158
11:00		94	95							189
12:00 PM		98	92							190
01:00		111	88							199
02:00		125	92							217
03:00		163	132							295
04:00		173	106							279
05:00		146	122							268
06:00		145	79							224
07:00		106	42							148
08:00		64	19							83
09:00		35	8							43
10:00		25	3							28
11:00		7	1							8
Total		1591	1630							3221
Percent		49.4%	50.6%							
AM Peak	-	11:00	07:00	-	-	-	-	-	-	08:00
Vol.	-	94	183	-	-	-	-	-	-	250
PM Peak	-	16:00	15:00	-	-	-	-	-	-	15:00
Vol.	-	173	132	-	-	-	-	-	-	295

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	25-Aug-22 Thu	EAST	WEST							Total
12:00 AM		10	1							11
01:00		4	0							4
02:00		1	2							3
03:00		2	4							6
04:00		0	17							17
05:00		3	48							51
06:00		11	98							109
07:00		53	192							245
08:00		79	180							259
09:00		71	148							219
10:00		66	98							164
11:00		99	86							185
12:00 PM		112	91							203
01:00		89	111							200
02:00		86	106							192
03:00		138	115							253
04:00		151	103							254
05:00		168	90							258
06:00		117	56							173
07:00		92	30							122
08:00		73	18							91
09:00		41	13							54
10:00		24	4							28
11:00		19	1							20
Total		1509	1612							3121
Percent		48.3%	51.7%							
AM Peak	-	11:00	07:00	-	-	-	-	-	-	08:00
Vol.	-	99	192	-	-	-	-	-	-	259
PM Peak	-	17:00	15:00	-	-	-	-	-	-	17:00
Vol.	-	168	115	-	-	-	-	-	-	258

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	26-Aug-22 Fri	EAST	WEST							Total
12:00 AM		8	0							8
01:00		2	2							4
02:00		3	3							6
03:00		0	4							4
04:00		0	21							21
05:00		2	45							47
06:00		7	84							91
07:00		52	166							218
08:00		58	165							223
09:00		85	107							192
10:00		85	144							229
11:00		102	100							202
12:00 PM		121	99							220
01:00		91	89							180
02:00		94	113							207
03:00		120	131							251
04:00		150	99							249
05:00		161	97							258
06:00		111	62							173
07:00		102	48							150
08:00		54	19							73
09:00		46	10							56
10:00		29	13							42
11:00		17	4							21
Total		1500	1625							3125
Percent		48.0%	52.0%							
AM Peak	-	11:00	07:00	-	-	-	-	-	-	10:00
Vol.	-	102	166	-	-	-	-	-	-	229
PM Peak	-	17:00	15:00	-	-	-	-	-	-	17:00
Vol.	-	161	131	-	-	-	-	-	-	258

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	27-Aug-22 Sat	EAST	WEST							Total
12:00 AM		14	2							16
01:00		7	1							8
02:00		3	5							8
03:00		0	5							5
04:00		0	10							10
05:00		2	10							12
06:00		10	40							50
07:00		22	82							104
08:00		58	115							173
09:00		74	132							206
10:00		111	135							246
11:00		111	124							235
12:00 PM		140	120							260
01:00		153	108							261
02:00		144	91							235
03:00		145	94							239
04:00		105	90							195
05:00		80	118							198
06:00		93	80							173
07:00		70	56							126
08:00		63	28							91
09:00		43	10							53
10:00		25	12							37
11:00		12	16							28
Total		1485	1484							2969
Percent		50.0%	50.0%							
AM Peak	-	10:00	10:00	-	-	-	-	-	-	10:00
Vol.	-	111	135	-	-	-	-	-	-	246
PM Peak	-	13:00	12:00	-	-	-	-	-	-	13:00
Vol.	-	153	120	-	-	-	-	-	-	261

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O CONIFER DR
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222218
 Station ID: 222218

Start Time	28-Aug-22 Sun	EAST	WEST	Total						
12:00 AM		12	3	15						
01:00		4	4	8						
02:00		2	1	3						
03:00		1	2	3						
04:00		3	4	7						
05:00		2	15	17						
06:00		6	21	27						
07:00		20	54	74						
08:00		39	65	104						
09:00		61	138	199						
10:00		105	109	214						
11:00		118	117	235						
12:00 PM		123	101	224						
01:00		98	156	254						
02:00		68	78	146						
03:00		1	0	1						
04:00		0	0	0						
05:00		*	*	*						
06:00		*	*	*						
07:00		*	*	*						
08:00		*	*	*						
09:00		*	*	*						
10:00		*	*	*						
11:00		*	*	*						
Total		663	868	1531						
Percent		43.3%	56.7%							
AM Peak	-	11:00	09:00	-	-	-	-	-	-	11:00
Vol.	-	118	138	-	-	-	-	-	-	235
PM Peak	-	12:00	13:00	-	-	-	-	-	-	13:00
Vol.	-	123	156	-	-	-	-	-	-	254
Grand Total		9196	9642							18838
Percent		48.8%	51.2%							
ADT		ADT 2,776	AADT 2,776							

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	22-Aug-22 Mon	EAST	WEST	Total
12:00 AM		*	*	*
01:00		*	*	*
02:00		*	*	*
03:00		*	*	*
04:00		*	*	*
05:00		*	*	*
06:00		*	*	*
07:00		*	*	*
08:00		*	*	*
09:00		*	*	*
10:00		*	*	*
11:00		*	*	*
12:00 PM		*	*	*
01:00		99	102	201
02:00		90	99	189
03:00		110	155	265
04:00		100	145	245
05:00		79	162	241
06:00		60	156	216
07:00		29	84	113
08:00		18	61	79
09:00		7	38	45
10:00		7	14	21
11:00		2	16	18
Total		601	1032	1633
Percent		36.8%	63.2%	
AM Peak	-	-	-	-
Vol.	-	-	-	-
PM Peak	-	15:00	17:00	15:00
Vol.	-	110	162	265

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	23-Aug-22 Tue	EAST	WEST							Total
12:00 AM		2	4							6
01:00		4	0							4
02:00		1	1							2
03:00		4	0							4
04:00		23	1							24
05:00		51	1							52
06:00		122	16							138
07:00		185	66							251
08:00		169	63							232
09:00		84	78							162
10:00		93	82							175
11:00		102	92							194
12:00 PM		158	60							218
01:00		184	0							184
02:00		207	0							207
03:00		270	0							270
04:00		266	0							266
05:00		290	0							290
06:00		217	0							217
07:00		125	0							125
08:00		105	0							105
09:00		52	0							52
10:00		27	0							27
11:00		21	0							21
Total		2762	464							3226
Percent		85.6%	14.4%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	07:00
Vol.	-	185	92	-	-	-	-	-	-	251
PM Peak	-	17:00	12:00	-	-	-	-	-	-	17:00
Vol.	-	290	60	-	-	-	-	-	-	290

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	24-Aug-22 Wed	EAST	WEST	Total					
12:00 AM		12	0	12					
01:00		4	0	4					
02:00		3	0	3					
03:00		5	0	5					
04:00		20	0	20					
05:00		55	0	55					
06:00		121	0	121					
07:00		253	0	253					
08:00		260	0	260					
09:00		180	0	180					
10:00		157	0	157					
11:00		196	0	196					
12:00 PM		191	0	191					
01:00		144	69	213					
02:00		105	119	224					
03:00		134	162	296					
04:00		119	178	297					
05:00		96	170	266					
06:00		64	171	235					
07:00		33	106	139					
08:00		17	64	81					
09:00		8	33	41					
10:00		3	25	28					
11:00		1	7	8					
Total		2181	1104	3285					
Percent		66.4%	33.6%						
AM Peak	-	08:00	-	-	-	-	-	-	08:00
Vol.	-	260	-	-	-	-	-	-	260
PM Peak	-	12:00	16:00	-	-	-	-	-	16:00
Vol.	-	191	178	-	-	-	-	-	297

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	25-Aug-22 Thu	EAST	WEST							Total
12:00 AM		1	11							12
01:00		0	3							3
02:00		2	1							3
03:00		4	2							6
04:00		17	0							17
05:00		48	3							51
06:00		100	11							111
07:00		180	67							247
08:00		180	85							265
09:00		124	80							204
10:00		98	65							163
11:00		95	98							193
12:00 PM		94	115							209
01:00		96	96							192
02:00		108	94							202
03:00		113	144							257
04:00		103	158							261
05:00		80	180							260
06:00		60	122							182
07:00		30	95							125
08:00		16	76							92
09:00		12	41							53
10:00		4	24							28
11:00		1	20							21
Total		1566	1591							3157
Percent		49.6%	50.4%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	08:00
Vol.	-	180	98	-	-	-	-	-	-	265
PM Peak	-	15:00	17:00	-	-	-	-	-	-	16:00
Vol.	-	113	180	-	-	-	-	-	-	261

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	26-Aug-22 Fri	EAST	WEST							Total
12:00 AM		0	7							7
01:00		2	3							5
02:00		3	2							5
03:00		2	2							4
04:00		22	0							22
05:00		45	3							48
06:00		87	7							94
07:00		166	59							225
08:00		168	63							231
09:00		102	84							186
10:00		130	88							218
11:00		107	104							211
12:00 PM		102	123							225
01:00		92	95							187
02:00		101	109							210
03:00		118	122							240
04:00		96	167							263
05:00		95	151							246
06:00		63	116							179
07:00		49	108							157
08:00		21	55							76
09:00		10	48							58
10:00		12	28							40
11:00		6	18							24
Total		1599	1562							3161
Percent		50.6%	49.4%							
AM Peak	-	08:00	11:00	-	-	-	-	-	-	08:00
Vol.	-	168	104	-	-	-	-	-	-	231
PM Peak	-	15:00	16:00	-	-	-	-	-	-	16:00
Vol.	-	118	167	-	-	-	-	-	-	263

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	27-Aug-22 Sat	EAST	WEST							Total
12:00 AM		2	15							17
01:00		1	7							8
02:00		5	3							8
03:00		5	0							5
04:00		10	0							10
05:00		10	2							12
06:00		40	11							51
07:00		82	23							105
08:00		116	60							176
09:00		126	81							207
10:00		151	108							259
11:00		135	102							237
12:00 PM		128	142							270
01:00		115	146							261
02:00		99	146							245
03:00		108	141							249
04:00		95	107							202
05:00		95	101							196
06:00		65	93							158
07:00		54	69							123
08:00		28	62							90
09:00		8	44							52
10:00		8	26							34
11:00		7	23							30
Total		1493	1512							3005
Percent		49.7%	50.3%							
AM Peak	-	10:00	10:00	-	-	-	-	-	-	10:00
Vol.	-	151	108	-	-	-	-	-	-	259
PM Peak	-	12:00	13:00	-	-	-	-	-	-	12:00
Vol.	-	128	146	-	-	-	-	-	-	270

COUNTER MEASURES INC.
1889 YORK STREET
DENVER, COLORADO 80206
303-333-7409

Location: SHADOW MTN DR W-O HWY 73
 City: CONIFER
 County: JEFFERSON
 Direction: EAST/WEST

Site Code: 222207
 Station ID: 222207

Start Time	28-Aug-22 Sun	EAST	WEST							Total
12:00 AM		3	13							16
01:00		4	3							7
02:00		1	2							3
03:00		3	1							4
04:00		4	3							7
05:00		15	4							19
06:00		22	7							29
07:00		56	21							77
08:00		67	43							110
09:00		131	61							192
10:00		127	99							226
11:00		132	107							239
12:00 PM		102	126							228
01:00		105	136							241
02:00		26	30							56
03:00		*	*							*
04:00		*	*							*
05:00		*	*							*
06:00		*	*							*
07:00		*	*							*
08:00		*	*							*
09:00		*	*							*
10:00		*	*							*
11:00		*	*							*
Total		798	656							1454
Percent		54.9%	45.1%							
AM Peak	-	11:00	11:00	-	-	-	-	-	-	11:00
Vol.	-	132	107	-	-	-	-	-	-	239
PM Peak	-	13:00	13:00	-	-	-	-	-	-	13:00
Vol.	-	105	136	-	-	-	-	-	-	241
Grand Total		11000	7921							18921
Percent		58.1%	41.9%							
ADT		ADT 2,782	AADT 2,782							

LEVEL OF SERVICE DEFINITIONS

From *Highway Capacity Manual*, Transportation Research Board, 2016, 6th Edition

UNSIGNALIZED INTERSECTION LEVEL OF SERVICE (LOS)

Applicable to Two-Way Stop Control, All-Way Stop Control, and Roundabouts

LOS	Average Vehicle Control Delay	<u>Operational Characteristics</u>
A	<10 seconds	Normally, vehicles on the stop-controlled approach only have to wait up to 10 seconds before being able to clear the intersection. Left-turning vehicles on the uncontrolled street do not have to wait to make their turn.
B	10 to 15 seconds	Vehicles on the stop-controlled approach will experience delays before being able to clear the intersection. <u>The delay could be up to 15 seconds.</u> Left-turning vehicles on the uncontrolled street may have to wait to make their turn.
C	15 to 25 seconds	Vehicles on the stop-controlled approach can expect delays in the range of 15 to 25 seconds before clearing the intersection. Motorists may begin to take chances due to the long delays, thereby posing a safety risk to through traffic. <u>Left-turning vehicles on the uncontrolled street will now be required to wait to make their turn causing a queue to be created in the turn lane.</u>
D	25 to 35 seconds	<u>This is the point at which a traffic signal may be warranted for this intersection.</u> The delays for the stop-controlled intersection are not considered to be excessive. The length of the queue may begin to block other public and private access points.
E	35 to 50 seconds	The delays for all critical traffic movements are considered to be unacceptable. The length of the queues for the stop-controlled approaches as well as the left-turn movements are extremely long. <u>There is a high probability that this intersection will meet traffic signal warrants.</u> The ability to install a traffic signal is affected by the location of other existing traffic signals. Consideration may be given to restricting the accesses by eliminating the left-turn movements from and to the stop-controlled approach.
F	>50 seconds	The delay for the critical traffic movements are probably in excess of 100 seconds. The length of the queues are extremely long. Motorists are selecting alternative routes due to the long delays. <u>The only remedy for these long delays is installing a traffic signal or restricting the accesses.</u> The potential for accidents at this intersection are extremely high due to motorist taking more risky chances. If the median permits, motorists begin making two-stage left-turns.

Intersection						
Int Delay, s/veh	3					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	433	16	183	310	8	100
Future Vol, veh/h	433	16	183	310	8	100
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	492	18	208	352	9	114

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	510	0	1260
Stage 1	-	-	-	-	492
Stage 2	-	-	-	-	768
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1055	-	188
Stage 1	-	-	-	-	615
Stage 2	-	-	-	-	458
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1055	-	151
Mov Cap-2 Maneuver	-	-	-	-	151
Stage 1	-	-	-	-	615
Stage 2	-	-	-	-	368

Approach	SE	NW	NE
HCM Control Delay, s	0	3.4	14.1
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	151	577	1055	-	-	-
HCM Lane V/C Ratio	0.06	0.197	0.197	-	-	-
HCM Control Delay (s)	30.4	12.8	9.2	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.2	0.7	0.7	-	-	-

Intersection						
Int Delay, s/veh	12					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	274	276	177	78	114	315
Future Vol, veh/h	274	276	177	78	114	315
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	311	314	201	89	130	358

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	290	0	-	0	1137 201
Stage 1	-	-	-	-	201 -
Stage 2	-	-	-	-	936 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1272	-	-	-	223 840
Stage 1	-	-	-	-	833 -
Stage 2	-	-	-	-	382 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1272	-	-	-	169 840
Mov Cap-2 Maneuver	-	-	-	-	169 -
Stage 1	-	-	-	-	630 -
Stage 2	-	-	-	-	382 -

Approach	SE	NW	SW
HCM Control Delay, s	4.4	0	28.8
HCM LOS			D

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1272	-	169	840
HCM Lane V/C Ratio	-	-	0.245	-	0.767	0.426
HCM Control Delay (s)	-	-	8.7	-	74.3	12.4
HCM Lane LOS	-	-	A	-	F	B
HCM 95th %tile Q(veh)	-	-	1	-	4.9	2.2

Intersection						
Int Delay, s/veh	2.9					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↖	↑	↖	↗
Traffic Vol, veh/h	269	9	87	294	12	120
Future Vol, veh/h	269	9	87	294	12	120
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	306	10	99	334	14	136

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	316	0	838	306
Stage 1	-	-	-	-	306	-
Stage 2	-	-	-	-	532	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1244	-	336	734
Stage 1	-	-	-	-	747	-
Stage 2	-	-	-	-	589	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1244	-	309	734
Mov Cap-2 Maneuver	-	-	-	-	309	-
Stage 1	-	-	-	-	747	-
Stage 2	-	-	-	-	542	-

Approach	SE	NW	NE
HCM Control Delay, s	0	1.9	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	309	734	1244	-	-	-
HCM Lane V/C Ratio	0.044	0.186	0.079	-	-	-
HCM Control Delay (s)	17.2	11	8.1	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	0.1	0.7	0.3	-	-	-

Intersection

Int Delay, s/veh 8.4

Movement SEL SET NWT NWR SWL SWR

Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	223	178	182	27	109	193
Future Vol, veh/h	223	178	182	27	109	193
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	253	202	207	31	124	219

Major/Minor Major1 Major2 Minor2

Conflicting Flow All	238	0	-	0	915	207
Stage 1	-	-	-	-	207	-
Stage 2	-	-	-	-	708	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1329	-	-	-	303	833
Stage 1	-	-	-	-	828	-
Stage 2	-	-	-	-	488	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1329	-	-	-	245	833
Mov Cap-2 Maneuver	-	-	-	-	245	-
Stage 1	-	-	-	-	671	-
Stage 2	-	-	-	-	488	-

Approach SE NW SW

HCM Control Delay, s	4.6	0	19.2
HCM LOS			C

Minor Lane/Major Mvmt NWT NWR SEL SETSWLn1SWLn2

Capacity (veh/h)	-	-	1329	-	245	833
HCM Lane V/C Ratio	-	-	0.191	-	0.506	0.263
HCM Control Delay (s)	-	-	8.3	-	33.8	10.9
HCM Lane LOS	-	-	A	-	D	B
HCM 95th %tile Q(veh)	-	-	0.7	-	2.6	1.1

Intersection						
Int Delay, s/veh	3.2					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	449	15	134	376	22	123
Future Vol, veh/h	449	15	134	376	22	123
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	510	17	152	427	25	140

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	527	0	1241
Stage 1	-	-	-	-	510
Stage 2	-	-	-	-	731
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1040	-	193
Stage 1	-	-	-	-	603
Stage 2	-	-	-	-	476
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1040	-	165
Mov Cap-2 Maneuver	-	-	-	-	165
Stage 1	-	-	-	-	603
Stage 2	-	-	-	-	407

Approach	SE	NW	NE
HCM Control Delay, s	0	2.4	16.1
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	165	563	1040	-	-	-
HCM Lane V/C Ratio	0.152	0.248	0.146	-	-	-
HCM Control Delay (s)	30.7	13.5	9.1	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.5	1	0.5	-	-	-

Intersection

Int Delay, s/veh 14.7

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	467	188	231	88	58	271
Future Vol, veh/h	467	188	231	88	58	271
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	531	214	263	100	66	308

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	363	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.12	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.218	-	-
Pot Cap-1 Maneuver	1196	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1196	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	SE	NW	SW
HCM Control Delay, s	7.4	0	43.3
HCM LOS			E

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1196	-	71	776
HCM Lane V/C Ratio	-	-	0.444	-	0.928	0.397
HCM Control Delay (s)	-	-	10.4	-	186	12.7
HCM Lane LOS	-	-	B	-	F	B
HCM 95th %tile Q(veh)	-	-	2.3	-	4.7	1.9

Intersection						
Int Delay, s/veh	2.9					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	218	11	60	253	24	112
Future Vol, veh/h	218	11	60	253	24	112
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	248	13	68	288	27	127

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	261	0	672
Stage 1	-	-	-	-	248
Stage 2	-	-	-	-	424
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1303	-	421
Stage 1	-	-	-	-	793
Stage 2	-	-	-	-	660
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1303	-	399
Mov Cap-2 Maneuver	-	-	-	-	399
Stage 1	-	-	-	-	793
Stage 2	-	-	-	-	626

Approach	SE	NW	NE
HCM Control Delay, s	0	1.5	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	399	791	1303	-	-	-
HCM Lane V/C Ratio	0.068	0.161	0.052	-	-	-
HCM Control Delay (s)	14.7	10.4	7.9	-	-	-
HCM Lane LOS	B	B	A	-	-	-
HCM 95th %tile Q(veh)	0.2	0.6	0.2	-	-	-

Intersection						
Int Delay, s/veh	4.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	208	115	187	18	12	137
Future Vol, veh/h	208	115	187	18	12	137
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	236	131	213	20	14	156
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	233	0	-	0	816	213
Stage 1	-	-	-	-	213	-
Stage 2	-	-	-	-	603	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1335	-	-	-	347	827
Stage 1	-	-	-	-	823	-
Stage 2	-	-	-	-	546	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1335	-	-	-	286	827
Mov Cap-2 Maneuver	-	-	-	-	286	-
Stage 1	-	-	-	-	677	-
Stage 2	-	-	-	-	546	-
Approach	SE	NW	SW			
HCM Control Delay, s	5.3	0	11			
HCM LOS			B			
Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1335	-	286	827
HCM Lane V/C Ratio	-	-	0.177	-	0.048	0.188
HCM Control Delay (s)	-	-	8.3	-	18.2	10.4
HCM Lane LOS	-	-	A	-	C	B
HCM 95th %tile Q(veh)	-	-	0.6	-	0.1	0.7

Intersection						
Int Delay, s/veh	2.8					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↖	↑	↖	↗
Traffic Vol, veh/h	315	18	131	354	12	108
Future Vol, veh/h	315	18	131	354	12	108
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	358	20	149	402	14	123

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	378	0	1058	358
Stage 1	-	-	-	-	358	-
Stage 2	-	-	-	-	700	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1180	-	249	686
Stage 1	-	-	-	-	707	-
Stage 2	-	-	-	-	493	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1180	-	218	686
Mov Cap-2 Maneuver	-	-	-	-	218	-
Stage 1	-	-	-	-	707	-
Stage 2	-	-	-	-	431	-

Approach	SE	NW	NE
HCM Control Delay, s	0	2.3	12.5
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	218	686	1180	-	-	-
HCM Lane V/C Ratio	0.063	0.179	0.126	-	-	-
HCM Control Delay (s)	22.6	11.4	8.5	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	0.2	0.6	0.4	-	-	-

Intersection						
Int Delay, s/veh	5.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	242	193	235	49	24	248
Future Vol, veh/h	242	193	235	49	24	248
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	275	219	267	56	27	282

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	323	0	-	0	1036 267
Stage 1	-	-	-	-	267 -
Stage 2	-	-	-	-	769 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1237	-	-	-	256 772
Stage 1	-	-	-	-	778 -
Stage 2	-	-	-	-	457 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1237	-	-	-	199 772
Mov Cap-2 Maneuver	-	-	-	-	199 -
Stage 1	-	-	-	-	605 -
Stage 2	-	-	-	-	457 -

Approach	SE	NW	SW
HCM Control Delay, s	4.9	0	13.5
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1237	-	199	772
HCM Lane V/C Ratio	-	-	0.222	-	0.137	0.365
HCM Control Delay (s)	-	-	8.7	-	25.9	12.3
HCM Lane LOS	-	-	A	-	D	B
HCM 95th %tile Q(veh)	-	-	0.9	-	0.5	1.7

Intersection						
Int Delay, s/veh	3.1					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	445	16	186	320	8	102
Future Vol, veh/h	445	16	186	320	8	102
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	506	18	211	364	9	116

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	524	0	1292
Stage 1	-	-	-	-	506
Stage 2	-	-	-	-	786
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1043	-	180
Stage 1	-	-	-	-	606
Stage 2	-	-	-	-	449
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1043	-	144
Mov Cap-2 Maneuver	-	-	-	-	144
Stage 1	-	-	-	-	606
Stage 2	-	-	-	-	358

Approach	SE	NW	NE
HCM Control Delay, s	0	3.4	14.4
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	144	566	1043	-	-	-
HCM Lane V/C Ratio	0.063	0.205	0.203	-	-	-
HCM Control Delay (s)	31.7	13	9.3	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.2	0.8	0.8	-	-	-

Intersection						
Int Delay, s/veh	13.2					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑	↑	↗	↘	↗
Traffic Vol, veh/h	280	280	180	80	117	325
Future Vol, veh/h	280	280	180	80	117	325
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	318	318	205	91	133	369

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	296	0	-	0	1159 205
Stage 1	-	-	-	-	205 -
Stage 2	-	-	-	-	954 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1265	-	-	-	216 836
Stage 1	-	-	-	-	829 -
Stage 2	-	-	-	-	374 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1265	-	-	-	162 836
Mov Cap-2 Maneuver	-	-	-	-	162 -
Stage 1	-	-	-	-	621 -
Stage 2	-	-	-	-	374 -

Approach	SE	NW	SW
HCM Control Delay, s	4.4	0	32.1
HCM LOS			D

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1265	-	162	836
HCM Lane V/C Ratio	-	-	0.252	-	0.821	0.442
HCM Control Delay (s)	-	-	8.8	-	86.1	12.7
HCM Lane LOS	-	-	A	-	F	B
HCM 95th %tile Q(veh)	-	-	1	-	5.5	2.3

Intersection						
Int Delay, s/veh	2.8					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	277	9	88	303	12	122
Future Vol, veh/h	277	9	88	303	12	122
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	315	10	100	344	14	139

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	325	0	859	315
Stage 1	-	-	-	-	315	-
Stage 2	-	-	-	-	544	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1235	-	327	725
Stage 1	-	-	-	-	740	-
Stage 2	-	-	-	-	582	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1235	-	301	725
Mov Cap-2 Maneuver	-	-	-	-	301	-
Stage 1	-	-	-	-	740	-
Stage 2	-	-	-	-	535	-

Approach	SE	NW	NE
HCM Control Delay, s	0	1.8	11.7
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	301	725	1235	-	-	-
HCM Lane V/C Ratio	0.045	0.191	0.081	-	-	-
HCM Control Delay (s)	17.5	11.1	8.2	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	0.1	0.7	0.3	-	-	-

Intersection						
Int Delay, s/veh	8.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	230	183	188	28	112	199
Future Vol, veh/h	230	183	188	28	112	199
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	261	208	214	32	127	226

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	246	0	-	0	944 214
Stage 1	-	-	-	-	214 -
Stage 2	-	-	-	-	730 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1320	-	-	-	291 826
Stage 1	-	-	-	-	822 -
Stage 2	-	-	-	-	477 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1320	-	-	-	233 826
Mov Cap-2 Maneuver	-	-	-	-	233 -
Stage 1	-	-	-	-	659 -
Stage 2	-	-	-	-	477 -

Approach	SE	NW	SW
HCM Control Delay, s	4.7	0	20.6
HCM LOS			C

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1320	-	233	826
HCM Lane V/C Ratio	-	-	0.198	-	0.546	0.274
HCM Control Delay (s)	-	-	8.4	-	37.6	11
HCM Lane LOS	-	-	A	-	E	B
HCM 95th %tile Q(veh)	-	-	0.7	-	3	1.1

Intersection						
Int Delay, s/veh	3.2					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	463	15	136	387	22	125
Future Vol, veh/h	463	15	136	387	22	125
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	526	17	155	440	25	142

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	543	0	1276 526
Stage 1	-	-	-	-	526 -
Stage 2	-	-	-	-	750 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1026	-	184 552
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	467 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1026	-	156 552
Mov Cap-2 Maneuver	-	-	-	-	156 -
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	396 -

Approach	SE	NW	NE
HCM Control Delay, s	0	2.4	16.6
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	156	552	1026	-	-	-
HCM Lane V/C Ratio	0.16	0.257	0.151	-	-	-
HCM Control Delay (s)	32.4	13.8	9.1	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.6	1	0.5	-	-	-

Intersection						
Int Delay, s/veh	16.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	480	194	238	91	60	279
Future Vol, veh/h	480	194	238	91	60	279
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	545	220	270	103	68	317

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	373	0	-	0	1580 270
Stage 1	-	-	-	-	270 -
Stage 2	-	-	-	-	1310 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1185	-	-	-	120 769
Stage 1	-	-	-	-	775 -
Stage 2	-	-	-	-	252 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1185	-	-	-	~ 65 769
Mov Cap-2 Maneuver	-	-	-	-	~ 65 -
Stage 1	-	-	-	-	419 -
Stage 2	-	-	-	-	252 -

Approach	SE	NW	SW
HCM Control Delay, s	7.6	0	51.9
HCM LOS			F

Minor Lane/Major Mvmt	NWT	NWR	SEL	SETSWLn1SWLn2		
Capacity (veh/h)	-	-	1185	-	65	769
HCM Lane V/C Ratio	-	-	0.46	-	1.049	0.412
HCM Control Delay (s)	-	-	10.6	-	233.5	12.9
HCM Lane LOS	-	-	B	-	F	B
HCM 95th %tile Q(veh)	-	-	2.5	-	5.3	2

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection						
Int Delay, s/veh	2.9					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	225	11	61	260	24	114
Future Vol, veh/h	225	11	61	260	24	114
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	256	13	69	295	27	130

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	269	0	689	256
Stage 1	-	-	-	-	256	-
Stage 2	-	-	-	-	433	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1295	-	412	783
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	654	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1295	-	390	783
Mov Cap-2 Maneuver	-	-	-	-	390	-
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	619	-

Approach	SE	NW	NE
HCM Control Delay, s	0	1.5	11.3
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	390	783	1295	-	-	-
HCM Lane V/C Ratio	0.07	0.165	0.054	-	-	-
HCM Control Delay (s)	14.9	10.5	7.9	-	-	-
HCM Lane LOS	B	B	A	-	-	-
HCM 95th %tile Q(veh)	0.2	0.6	0.2	-	-	-

Intersection						
Int Delay, s/veh	5					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	214	118	193	19	12	141
Future Vol, veh/h	214	118	193	19	12	141
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	243	134	219	22	14	160

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	241	0	0	839	219
Stage 1	-	-	-	219	-
Stage 2	-	-	-	620	-
Critical Hdwy	4.12	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	3.518	3.318
Pot Cap-1 Maneuver	1326	-	-	336	821
Stage 1	-	-	-	817	-
Stage 2	-	-	-	536	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1326	-	-	275	821
Mov Cap-2 Maneuver	-	-	-	275	-
Stage 1	-	-	-	667	-
Stage 2	-	-	-	536	-

Approach	SE	NW	SW
HCM Control Delay, s	5.4	0	11.1
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1326	-	275	821
HCM Lane V/C Ratio	-	-	0.183	-	0.05	0.195
HCM Control Delay (s)	-	-	8.3	-	18.8	10.4
HCM Lane LOS	-	-	A	-	C	B
HCM 95th %tile Q(veh)	-	-	0.7	-	0.2	0.7

Intersection						
Int Delay, s/veh	2.8					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	325	18	133	365	12	110
Future Vol, veh/h	325	18	133	365	12	110
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	369	20	151	415	14	125

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	389	0	1086 369
Stage 1	-	-	-	-	369 -
Stage 2	-	-	-	-	717 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1170	-	239 677
Stage 1	-	-	-	-	699 -
Stage 2	-	-	-	-	484 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1170	-	208 677
Mov Cap-2 Maneuver	-	-	-	-	208 -
Stage 1	-	-	-	-	699 -
Stage 2	-	-	-	-	422 -

Approach	SE	NW	NE
HCM Control Delay, s	0	2.3	12.7
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	208	677	1170	-	-	-
HCM Lane V/C Ratio	0.066	0.185	0.129	-	-	-
HCM Control Delay (s)	23.5	11.5	8.5	-	-	-
HCM Lane LOS	C	B	A	-	-	-
HCM 95th %tile Q(veh)	0.2	0.7	0.4	-	-	-

Intersection						
Int Delay, s/veh	6					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑	↑	↗	↘	↗
Traffic Vol, veh/h	249	199	242	50	25	255
Future Vol, veh/h	249	199	242	50	25	255
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	283	226	275	57	28	290

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	332	0	-	0	1067 275
Stage 1	-	-	-	-	275 -
Stage 2	-	-	-	-	792 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1227	-	-	-	246 764
Stage 1	-	-	-	-	771 -
Stage 2	-	-	-	-	446 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1227	-	-	-	189 764
Mov Cap-2 Maneuver	-	-	-	-	189 -
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	446 -

Approach	SE	NW	SW
HCM Control Delay, s	4.9	0	13.9
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1227	-	189	764
HCM Lane V/C Ratio	-	-	0.231	-	0.15	0.379
HCM Control Delay (s)	-	-	8.8	-	27.4	12.6
HCM Lane LOS	-	-	A	-	D	B
HCM 95th %tile Q(veh)	-	-	0.9	-	0.5	1.8

Intersection						
Int Delay, s/veh	4					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	445	28	289	320	9	112
Future Vol, veh/h	445	28	289	320	9	112
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	506	32	328	364	10	127

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	538	0	1526 506
Stage 1	-	-	-	-	506 -
Stage 2	-	-	-	-	1020 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1030	-	130 566
Stage 1	-	-	-	-	606 -
Stage 2	-	-	-	-	348 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1030	-	89 566
Mov Cap-2 Maneuver	-	-	-	-	89 -
Stage 1	-	-	-	-	606 -
Stage 2	-	-	-	-	237 -

Approach	SE	NW	NE
HCM Control Delay, s	0	4.8	16
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	89	566	1030	-	-	-
HCM Lane V/C Ratio	0.115	0.225	0.319	-	-	-
HCM Control Delay (s)	50.6	13.2	10.1	-	-	-
HCM Lane LOS	F	B	B	-	-	-
HCM 95th %tile Q(veh)	0.4	0.9	1.4	-	-	-

Intersection						
Int Delay, s/veh	15.2					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑	↑	↗	↘	↗
Traffic Vol, veh/h	288	282	197	80	117	411
Future Vol, veh/h	288	282	197	80	117	411
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	327	320	224	91	133	467

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	315	0	0	1198	224
Stage 1	-	-	-	224	-
Stage 2	-	-	-	974	-
Critical Hdwy	4.12	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	3.518	3.318
Pot Cap-1 Maneuver	1245	-	-	205	815
Stage 1	-	-	-	813	-
Stage 2	-	-	-	366	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1245	-	-	151	815
Mov Cap-2 Maneuver	-	-	-	151	-
Stage 1	-	-	-	599	-
Stage 2	-	-	-	366	-

Approach	SE	NW	SW
HCM Control Delay, s	4.5	0	34.6
HCM LOS			D

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1245	-	151	815
HCM Lane V/C Ratio	-	-	0.263	-	0.88	0.573
HCM Control Delay (s)	-	-	8.9	-	102.8	15.2
HCM Lane LOS	-	-	A	-	F	C
HCM 95th %tile Q(veh)	-	-	1.1	-	6	3.7

Intersection						
Int Delay, s/veh	3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	75	0	115	130	0	11
Future Vol, veh/h	75	0	115	130	0	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	85	0	131	148	0	13

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	85	0	495 85
Stage 1	-	-	-	-	85 -
Stage 2	-	-	-	-	410 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1512	-	534 974
Stage 1	-	-	-	-	938 -
Stage 2	-	-	-	-	670 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1512	-	488 974
Mov Cap-2 Maneuver	-	-	-	-	488 -
Stage 1	-	-	-	-	938 -
Stage 2	-	-	-	-	612 -

Approach	EB	WB	NB
HCM Control Delay, s	0	3.6	8.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	974	-	-	1512	-
HCM Lane V/C Ratio	0.013	-	-	0.086	-
HCM Control Delay (s)	8.7	-	-	7.6	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0.3	-

Intersection						
Int Delay, s/veh	4.5					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	277	31	286	303	14	141
Future Vol, veh/h	277	31	286	303	14	141
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	315	35	325	344	16	160

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	350	0	1309 315
Stage 1	-	-	-	-	315 -
Stage 2	-	-	-	-	994 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1209	-	176 725
Stage 1	-	-	-	-	740 -
Stage 2	-	-	-	-	358 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1209	-	129 725
Mov Cap-2 Maneuver	-	-	-	-	129 -
Stage 1	-	-	-	-	740 -
Stage 2	-	-	-	-	262 -

Approach	SE	NW	NE
HCM Control Delay, s	0	4.4	13.7
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	129	725	1209	-	-	-
HCM Lane V/C Ratio	0.123	0.221	0.269	-	-	-
HCM Control Delay (s)	36.8	11.4	9.1	-	-	-
HCM Lane LOS	E	B	A	-	-	-
HCM 95th %tile Q(veh)	0.4	0.8	1.1	-	-	-

Intersection						
Int Delay, s/veh	11					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	246	186	221	28	112	364
Future Vol, veh/h	246	186	221	28	112	364
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	280	211	251	32	127	414

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	283	0	-	0	1022 251
Stage 1	-	-	-	-	251 -
Stage 2	-	-	-	-	771 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1279	-	-	-	261 788
Stage 1	-	-	-	-	791 -
Stage 2	-	-	-	-	456 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1279	-	-	-	204 788
Mov Cap-2 Maneuver	-	-	-	-	204 -
Stage 1	-	-	-	-	618 -
Stage 2	-	-	-	-	456 -

Approach	SE	NW	SW
HCM Control Delay, s	4.9	0	22.4
HCM LOS			C

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1279	-	204	788
HCM Lane V/C Ratio	-	-	0.219	-	0.624	0.525
HCM Control Delay (s)	-	-	8.6	-	48.1	14.5
HCM Lane LOS	-	-	A	-	E	B
HCM 95th %tile Q(veh)	-	-	0.8	-	3.6	3.1

Intersection						
Int Delay, s/veh	4.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	90	0	220	65	0	21
Future Vol, veh/h	90	0	220	65	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	102	0	250	74	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	102	0	676
Stage 1	-	-	-	-	102
Stage 2	-	-	-	-	574
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1490	-	419
Stage 1	-	-	-	-	922
Stage 2	-	-	-	-	563
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1490	-	349
Mov Cap-2 Maneuver	-	-	-	-	349
Stage 1	-	-	-	-	922
Stage 2	-	-	-	-	468

Approach	EB	WB	NB
HCM Control Delay, s	0	6.1	8.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	953	-	-	1490	-
HCM Lane V/C Ratio	0.025	-	-	0.168	-
HCM Control Delay (s)	8.9	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	-

Intersection						
Int Delay, s/veh	6					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	463	17	149	387	38	264
Future Vol, veh/h	463	17	149	387	38	264
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	526	19	169	440	43	300

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	545	0	1304 526
Stage 1	-	-	-	-	526 -
Stage 2	-	-	-	-	778 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1024	-	177 552
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	453 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1024	-	148 552
Mov Cap-2 Maneuver	-	-	-	-	148 -
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	378 -

Approach	SE	NW	NE
HCM Control Delay, s	0	2.6	21.5
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	148	552	1024	-	-	-
HCM Lane V/C Ratio	0.292	0.543	0.165	-	-	-
HCM Control Delay (s)	39	19	9.2	-	-	-
HCM Lane LOS	E	C	A	-	-	-
HCM 95th %tile Q(veh)	1.1	3.2	0.6	-	-	-

Intersection						
Int Delay, s/veh	36.3					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	596	217	240	91	60	290
Future Vol, veh/h	596	217	240	91	60	290
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	677	247	273	103	68	330

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	376	0	-	0	1874 273
Stage 1	-	-	-	-	273 -
Stage 2	-	-	-	-	1601 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1182	-	-	-	79 766
Stage 1	-	-	-	-	773 -
Stage 2	-	-	-	-	182 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1182	-	-	-	~ 34 766
Mov Cap-2 Maneuver	-	-	-	-	~ 34 -
Stage 1	-	-	-	-	330 -
Stage 2	-	-	-	-	182 -

Approach	SE	NW	SW
HCM Control Delay, s	8.8	0	134.4
HCM LOS			F

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1182	-	34	766
HCM Lane V/C Ratio	-	-	0.573	-	2.005	0.43
HCM Control Delay (s)	-	-	12	-	720.1	13.2
HCM Lane LOS	-	-	B	-	F	B
HCM 95th %tile Q(veh)	-	-	3.8	-	7.6	2.2

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection						
Int Delay, s/veh	4.3					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	110	0	15	100	0	155
Future Vol, veh/h	110	0	15	100	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	125	0	17	114	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	125	0	273
Stage 1	-	-	-	-	125
Stage 2	-	-	-	-	148
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1462	-	716
Stage 1	-	-	-	-	901
Stage 2	-	-	-	-	880
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1462	-	707
Mov Cap-2 Maneuver	-	-	-	-	707
Stage 1	-	-	-	-	901
Stage 2	-	-	-	-	869

Approach	EB	WB	NB
HCM Control Delay, s	0	1	9.8
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	926	-	-	1462	-
HCM Lane V/C Ratio	0.19	-	-	0.012	-
HCM Control Delay (s)	9.8	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.7	-	-	0	-

Intersection						
Int Delay, s/veh	4.7					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	225	33	259	260	26	133
Future Vol, veh/h	225	33	259	260	26	133
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	256	38	294	295	30	151

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	294	0	1139	256
Stage 1	-	-	-	-	256	-
Stage 2	-	-	-	-	883	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1268	-	223	783
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	404	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1268	-	171	783
Mov Cap-2 Maneuver	-	-	-	-	171	-
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	310	-

Approach	SE	NW	NE
HCM Control Delay, s	0	4.3	13.9
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	171	783	1268	-	-	-
HCM Lane V/C Ratio	0.173	0.193	0.232	-	-	-
HCM Control Delay (s)	30.4	10.7	8.7	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.6	0.7	0.9	-	-	-

Intersection						
Int Delay, s/veh	6.8					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑	↑	↗	↘	↗
Traffic Vol, veh/h	230	121	226	19	12	306
Future Vol, veh/h	230	121	226	19	12	306
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	261	138	257	22	14	348

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	279	0	0	917	257
Stage 1	-	-	-	257	-
Stage 2	-	-	-	660	-
Critical Hdwy	4.12	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	3.518	3.318
Pot Cap-1 Maneuver	1284	-	-	302	782
Stage 1	-	-	-	786	-
Stage 2	-	-	-	514	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	1284	-	-	241	782
Mov Cap-2 Maneuver	-	-	-	241	-
Stage 1	-	-	-	626	-
Stage 2	-	-	-	514	-

Approach	SE	NW	SW
HCM Control Delay, s	5.6	0	13.5
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1284	-	241	782
HCM Lane V/C Ratio	-	-	0.204	-	0.057	0.445
HCM Control Delay (s)	-	-	8.5	-	20.8	13.2
HCM Lane LOS	-	-	A	-	C	B
HCM 95th %tile Q(veh)	-	-	0.8	-	0.2	2.3

Intersection						
Int Delay, s/veh	5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↶		↷	↶	↷	
Traffic Vol, veh/h	85	0	220	60	0	21
Future Vol, veh/h	85	0	220	60	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	97	0	250	68	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	97	0	665
Stage 1	-	-	-	-	97
Stage 2	-	-	-	-	568
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1496	-	425
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	567
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1496	-	354
Mov Cap-2 Maneuver	-	-	-	-	354
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	472

Approach	EB	WB	NB
HCM Control Delay, s	0	6.2	8.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	959	-	-	1496	-
HCM Lane V/C Ratio	0.025	-	-	0.167	-
HCM Control Delay (s)	8.9	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	-

Intersection						
Int Delay, s/veh	4.9					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	325	20	146	365	28	249
Future Vol, veh/h	325	20	146	365	28	249
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	369	23	166	415	32	283

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	392	0	1116 369
Stage 1	-	-	-	-	369 -
Stage 2	-	-	-	-	747 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1167	-	230 677
Stage 1	-	-	-	-	699 -
Stage 2	-	-	-	-	468 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1167	-	197 677
Mov Cap-2 Maneuver	-	-	-	-	197 -
Stage 1	-	-	-	-	699 -
Stage 2	-	-	-	-	402 -

Approach	SE	NW	NE
HCM Control Delay, s	0	2.5	15.4
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	197	677	1167	-	-	-
HCM Lane V/C Ratio	0.162	0.418	0.142	-	-	-
HCM Control Delay (s)	26.8	14.1	8.6	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.6	2.1	0.5	-	-	-

Intersection						
Int Delay, s/veh	6.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	365	222	244	50	25	266
Future Vol, veh/h	365	222	244	50	25	266
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	415	252	277	57	28	302

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	334	0	-	0	1359 277
Stage 1	-	-	-	-	277 -
Stage 2	-	-	-	-	1082 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1225	-	-	-	164 762
Stage 1	-	-	-	-	770 -
Stage 2	-	-	-	-	325 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1225	-	-	-	108 762
Mov Cap-2 Maneuver	-	-	-	-	108 -
Stage 1	-	-	-	-	509 -
Stage 2	-	-	-	-	325 -

Approach	SE	NW	SW
HCM Control Delay, s	5.9	0	16
HCM LOS			C

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1225	-	108	762
HCM Lane V/C Ratio	-	-	0.339	-	0.263	0.397
HCM Control Delay (s)	-	-	9.4	-	49.8	12.8
HCM Lane LOS	-	-	A	-	E	B
HCM 95th %tile Q(veh)	-	-	1.5	-	1	1.9

Intersection						
Int Delay, s/veh	4.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	95	0	15	90	0	155
Future Vol, veh/h	95	0	15	90	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	108	0	17	102	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	108	0	244
Stage 1	-	-	-	-	108
Stage 2	-	-	-	-	136
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1483	-	744
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	890
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1483	-	736
Mov Cap-2 Maneuver	-	-	-	-	736
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	880

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	9.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	946	-	-	1483	-
HCM Lane V/C Ratio	0.186	-	-	0.011	-
HCM Control Delay (s)	9.7	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.7	-	-	0	-

Intersection						
Int Delay, s/veh	4					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	445	28	289	320	9	112
Future Vol, veh/h	445	28	289	320	9	112
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	506	32	328	364	10	127

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	538	0	1526 506
Stage 1	-	-	-	-	506 -
Stage 2	-	-	-	-	1020 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1030	-	130 566
Stage 1	-	-	-	-	606 -
Stage 2	-	-	-	-	348 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1030	-	89 566
Mov Cap-2 Maneuver	-	-	-	-	89 -
Stage 1	-	-	-	-	606 -
Stage 2	-	-	-	-	237 -

Approach	SE	NW	NE
HCM Control Delay, s	0	4.8	16
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	89	566	1030	-	-	-
HCM Lane V/C Ratio	0.115	0.225	0.319	-	-	-
HCM Control Delay (s)	50.6	13.2	10.1	-	-	-
HCM Lane LOS	F	B	B	-	-	-
HCM 95th %tile Q(veh)	0.4	0.9	1.4	-	-	-

Intersection						
Int Delay, s/veh	15.2					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	288	282	197	80	117	411
Future Vol, veh/h	288	282	197	80	117	411
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	327	320	224	91	133	467

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	315	0	-	0	1198 224
Stage 1	-	-	-	-	224 -
Stage 2	-	-	-	-	974 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1245	-	-	-	205 815
Stage 1	-	-	-	-	813 -
Stage 2	-	-	-	-	366 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1245	-	-	-	151 815
Mov Cap-2 Maneuver	-	-	-	-	151 -
Stage 1	-	-	-	-	599 -
Stage 2	-	-	-	-	366 -

Approach	SE	NW	SW
HCM Control Delay, s	4.5	0	34.6
HCM LOS			D

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1245	-	151	815
HCM Lane V/C Ratio	-	-	0.263	-	0.88	0.573
HCM Control Delay (s)	-	-	8.9	-	102.8	15.2
HCM Lane LOS	-	-	A	-	F	C
HCM 95th %tile Q(veh)	-	-	1.1	-	6	3.7

Intersection						
Int Delay, s/veh	2.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	75	0	115	130	0	11
Future Vol, veh/h	75	0	115	130	0	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	85	0	131	148	0	13

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	85	0	495
Stage 1	-	-	-	-	85
Stage 2	-	-	-	-	410
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1512	-	534
Stage 1	-	-	-	-	938
Stage 2	-	-	-	-	670
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1512	-	488
Mov Cap-2 Maneuver	-	-	-	-	488
Stage 1	-	-	-	-	938
Stage 2	-	-	-	-	612

Approach	EB	WB	NB
HCM Control Delay, s	0	3.6	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1512	-
HCM Lane V/C Ratio	-	-	-	0.086	-
HCM Control Delay (s)	0	-	-	7.6	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0.3	-

Intersection						
Int Delay, s/veh	4.5					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	277	31	286	303	14	141
Future Vol, veh/h	277	31	286	303	14	141
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	315	35	325	344	16	160

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	350	0	1309 315
Stage 1	-	-	-	-	315 -
Stage 2	-	-	-	-	994 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1209	-	176 725
Stage 1	-	-	-	-	740 -
Stage 2	-	-	-	-	358 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1209	-	129 725
Mov Cap-2 Maneuver	-	-	-	-	129 -
Stage 1	-	-	-	-	740 -
Stage 2	-	-	-	-	262 -

Approach	SE	NW	NE
HCM Control Delay, s	0	4.4	13.7
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	129	725	1209	-	-	-
HCM Lane V/C Ratio	0.123	0.221	0.269	-	-	-
HCM Control Delay (s)	36.8	11.4	9.1	-	-	-
HCM Lane LOS	E	B	A	-	-	-
HCM 95th %tile Q(veh)	0.4	0.8	1.1	-	-	-

Intersection						
Int Delay, s/veh	11					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	246	186	221	28	112	364
Future Vol, veh/h	246	186	221	28	112	364
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	280	211	251	32	127	414

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	283	0	0 1022 251
Stage 1	-	-	- 251 -
Stage 2	-	-	- 771 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1279	-	- 261 788
Stage 1	-	-	- 791 -
Stage 2	-	-	- 456 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1279	-	- 204 788
Mov Cap-2 Maneuver	-	-	- 204 -
Stage 1	-	-	- 618 -
Stage 2	-	-	- 456 -

Approach	SE	NW	SW
HCM Control Delay, s	4.9	0	22.4
HCM LOS			C

Minor Lane/Major Mvmt	NWT	NWR	SEL	SETSWLn1	SWLn2
Capacity (veh/h)	-	-	1279	-	204 788
HCM Lane V/C Ratio	-	-	0.219	-	0.624 0.525
HCM Control Delay (s)	-	-	8.6	-	48.1 14.5
HCM Lane LOS	-	-	A	-	E B
HCM 95th %tile Q(veh)	-	-	0.8	-	3.6 3.1

Intersection						
Int Delay, s/veh	4.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	90	0	220	65	0	21
Future Vol, veh/h	90	0	220	65	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	102	0	250	74	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	102	0	676
Stage 1	-	-	-	-	102
Stage 2	-	-	-	-	574
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1490	-	419
Stage 1	-	-	-	-	922
Stage 2	-	-	-	-	563
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1490	-	349
Mov Cap-2 Maneuver	-	-	-	-	349
Stage 1	-	-	-	-	922
Stage 2	-	-	-	-	468

Approach	EB	WB	NB
HCM Control Delay, s	0	6.1	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1490	-
HCM Lane V/C Ratio	-	-	-	0.168	-
HCM Control Delay (s)	0	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0.6	-

Intersection						
Int Delay, s/veh	6					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	463	17	149	387	38	264
Future Vol, veh/h	463	17	149	387	38	264
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	526	19	169	440	43	300

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	545	0	1304 526
Stage 1	-	-	-	-	526 -
Stage 2	-	-	-	-	778 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1024	-	177 552
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	453 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1024	-	148 552
Mov Cap-2 Maneuver	-	-	-	-	148 -
Stage 1	-	-	-	-	593 -
Stage 2	-	-	-	-	378 -

Approach	SE	NW	NE
HCM Control Delay, s	0	2.6	21.5
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	148	552	1024	-	-	-
HCM Lane V/C Ratio	0.292	0.543	0.165	-	-	-
HCM Control Delay (s)	39	19	9.2	-	-	-
HCM Lane LOS	E	C	A	-	-	-
HCM 95th %tile Q(veh)	1.1	3.2	0.6	-	-	-

Intersection						
Int Delay, s/veh	36.3					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	596	217	240	91	60	290
Future Vol, veh/h	596	217	240	91	60	290
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	677	247	273	103	68	330

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	376	0	-	0	1874 273
Stage 1	-	-	-	-	273 -
Stage 2	-	-	-	-	1601 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1182	-	-	-	79 766
Stage 1	-	-	-	-	773 -
Stage 2	-	-	-	-	182 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1182	-	-	-	~ 34 766
Mov Cap-2 Maneuver	-	-	-	-	~ 34 -
Stage 1	-	-	-	-	330 -
Stage 2	-	-	-	-	182 -

Approach	SE	NW	SW
HCM Control Delay, s	8.8	0	134.4
HCM LOS			F

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1182	-	34	766
HCM Lane V/C Ratio	-	-	0.573	-	2.005	0.43
HCM Control Delay (s)	-	-	12	-	720.1	13.2
HCM Lane LOS	-	-	B	-	F	B
HCM 95th %tile Q(veh)	-	-	3.8	-	7.6	2.2

Notes
 ~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↶		↷	↶	↷	
Traffic Vol, veh/h	110	0	15	100	0	155
Future Vol, veh/h	110	0	15	100	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	125	0	17	114	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	125	0	273
Stage 1	-	-	-	-	125
Stage 2	-	-	-	-	148
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1462	-	716
Stage 1	-	-	-	-	901
Stage 2	-	-	-	-	880
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1462	-	707
Mov Cap-2 Maneuver	-	-	-	-	707
Stage 1	-	-	-	-	901
Stage 2	-	-	-	-	869

Approach	EB	WB	NB
HCM Control Delay, s	0	1	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1462	-
HCM Lane V/C Ratio	-	-	-	0.012	-
HCM Control Delay (s)	0	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection						
Int Delay, s/veh	4.7					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	225	33	259	260	26	133
Future Vol, veh/h	225	33	259	260	26	133
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	256	38	294	295	30	151

Major/Minor	Major1	Major2	Minor1			
Conflicting Flow All	0	0	294	0	1139	256
Stage 1	-	-	-	-	256	-
Stage 2	-	-	-	-	883	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1268	-	223	783
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	404	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1268	-	171	783
Mov Cap-2 Maneuver	-	-	-	-	171	-
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	310	-

Approach	SE	NW	NE
HCM Control Delay, s	0	4.3	13.9
HCM LOS			B

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	171	783	1268	-	-	-
HCM Lane V/C Ratio	0.173	0.193	0.232	-	-	-
HCM Control Delay (s)	30.4	10.7	8.7	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.6	0.7	0.9	-	-	-

Intersection						
Int Delay, s/veh	6.8					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↑	↑	↗	↘	↗
Traffic Vol, veh/h	230	121	226	19	12	306
Future Vol, veh/h	230	121	226	19	12	306
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	261	138	257	22	14	348

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	279	0	-	0	917 257
Stage 1	-	-	-	-	257 -
Stage 2	-	-	-	-	660 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1284	-	-	-	302 782
Stage 1	-	-	-	-	786 -
Stage 2	-	-	-	-	514 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1284	-	-	-	241 782
Mov Cap-2 Maneuver	-	-	-	-	241 -
Stage 1	-	-	-	-	626 -
Stage 2	-	-	-	-	514 -

Approach	SE	NW	SW
HCM Control Delay, s	5.6	0	13.5
HCM LOS			B

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1284	-	241	782
HCM Lane V/C Ratio	-	-	0.204	-	0.057	0.445
HCM Control Delay (s)	-	-	8.5	-	20.8	13.2
HCM Lane LOS	-	-	A	-	C	B
HCM 95th %tile Q(veh)	-	-	0.8	-	0.2	2.3

Intersection						
Int Delay, s/veh	4.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	85	0	220	60	0	21
Future Vol, veh/h	85	0	220	60	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	97	0	250	68	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	97	0	665
Stage 1	-	-	-	-	97
Stage 2	-	-	-	-	568
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1496	-	425
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	567
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1496	-	354
Mov Cap-2 Maneuver	-	-	-	-	354
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	472

Approach	EB	WB	NB
HCM Control Delay, s	0	6.2	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1496	-
HCM Lane V/C Ratio	-	-	-	0.167	-
HCM Control Delay (s)	0	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0.6	-

Intersection						
Int Delay, s/veh	4.9					
Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations	↑	↗	↘	↑	↘	↗
Traffic Vol, veh/h	325	20	146	365	28	249
Future Vol, veh/h	325	20	146	365	28	249
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	245	485	-	105	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	369	23	166	415	32	283

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	392	0	1116 369
Stage 1	-	-	-	-	369 -
Stage 2	-	-	-	-	747 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1167	-	230 677
Stage 1	-	-	-	-	699 -
Stage 2	-	-	-	-	468 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1167	-	197 677
Mov Cap-2 Maneuver	-	-	-	-	197 -
Stage 1	-	-	-	-	699 -
Stage 2	-	-	-	-	402 -

Approach	SE	NW	NE
HCM Control Delay, s	0	2.5	15.4
HCM LOS			C

Minor Lane/Major Mvmt	NELn1	NELn2	NWL	NWT	SET	SER
Capacity (veh/h)	197	677	1167	-	-	-
HCM Lane V/C Ratio	0.162	0.418	0.142	-	-	-
HCM Control Delay (s)	26.8	14.1	8.6	-	-	-
HCM Lane LOS	D	B	A	-	-	-
HCM 95th %tile Q(veh)	0.6	2.1	0.5	-	-	-

Intersection						
Int Delay, s/veh	6.9					
Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations	↘	↗	↗	↘	↘	↘
Traffic Vol, veh/h	365	222	244	50	25	266
Future Vol, veh/h	365	222	244	50	25	266
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	325	-	-	270	150	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	415	252	277	57	28	302

Major/Minor	Major1	Major2	Minor2		
Conflicting Flow All	334	0	-	0	1359 277
Stage 1	-	-	-	-	277 -
Stage 2	-	-	-	-	1082 -
Critical Hdwy	4.12	-	-	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	2.218	-	-	-	3.518 3.318
Pot Cap-1 Maneuver	1225	-	-	-	164 762
Stage 1	-	-	-	-	770 -
Stage 2	-	-	-	-	325 -
Platoon blocked, %		-	-	-	
Mov Cap-1 Maneuver	1225	-	-	-	108 762
Mov Cap-2 Maneuver	-	-	-	-	108 -
Stage 1	-	-	-	-	509 -
Stage 2	-	-	-	-	325 -

Approach	SE	NW	SW
HCM Control Delay, s	5.9	0	16
HCM LOS			C

Minor Lane/Major Mvmt	NWT	NWR	SEL	SET	SWLn1	SWLn2
Capacity (veh/h)	-	-	1225	-	108	762
HCM Lane V/C Ratio	-	-	0.339	-	0.263	0.397
HCM Control Delay (s)	-	-	9.4	-	49.8	12.8
HCM Lane LOS	-	-	A	-	E	B
HCM 95th %tile Q(veh)	-	-	1.5	-	1	1.9

Intersection						
Int Delay, s/veh	0.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	95	0	15	90	0	155
Future Vol, veh/h	95	0	15	90	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	280	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	108	0	17	102	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	108	0	244
Stage 1	-	-	-	-	108
Stage 2	-	-	-	-	136
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1483	-	744
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	890
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1483	-	736
Mov Cap-2 Maneuver	-	-	-	-	736
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	880

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1483	-
HCM Lane V/C Ratio	-	-	-	0.011	-
HCM Control Delay (s)	0	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection			
Intersection Delay, s/veh	9.1		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	625	659	136
Demand Flow Rate, veh/h	637	673	139
Vehicles Circulating, veh/h	232	11	614
Vehicles Exiting, veh/h	452	741	255
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.9	7.8	7.1
Approach LOS	B	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	637	673	139
Cap Entry Lane, veh/h	1089	1364	738
Entry HV Adj Factor	0.981	0.980	0.978
Flow Entry, veh/h	625	659	136
Cap Entry, veh/h	1069	1337	722
V/C Ratio	0.585	0.493	0.188
Control Delay, s/veh	10.9	7.8	7.1
LOS	B	A	A
95th %tile Queue, veh	4	3	1

Intersection			
Intersection Delay, s/veh	10.4		
Intersection LOS	B		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	728	335	591
Demand Flow Rate, veh/h	742	342	603
Vehicles Circulating, veh/h	162	371	232
Vehicles Exiting, veh/h	673	533	481
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	11.6	7.9	10.2
Approach LOS	B	A	B
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	742	342	603
Cap Entry Lane, veh/h	1170	945	1089
Entry HV Adj Factor	0.981	0.981	0.980
Flow Entry, veh/h	728	335	591
Cap Entry, veh/h	1147	927	1067
V/C Ratio	0.634	0.362	0.554
Control Delay, s/veh	11.6	7.9	10.2
LOS	B	A	B
95th %tile Queue, veh	5	2	4

Intersection			
Intersection Delay, s/veh	6.1		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	386	518	166
Demand Flow Rate, veh/h	393	528	169
Vehicles Circulating, veh/h	111	15	382
Vehicles Exiting, veh/h	432	536	122
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	6.0	6.4	5.7
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	393	528	169
Cap Entry Lane, veh/h	1232	1359	935
Entry HV Adj Factor	0.981	0.981	0.982
Flow Entry, veh/h	386	518	166
Cap Entry, veh/h	1209	1333	918
V/C Ratio	0.319	0.389	0.181
Control Delay, s/veh	6.0	6.4	5.7
LOS	A	A	A
95th %tile Queue, veh	1	2	1

Intersection			
Intersection Delay, s/veh	7.8		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	556	294	425
Demand Flow Rate, veh/h	567	300	433
Vehicles Circulating, veh/h	155	318	261
Vehicles Exiting, veh/h	539	404	357
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.4	6.8	7.9
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	567	300	433
Cap Entry Lane, veh/h	1178	998	1057
Entry HV Adj Factor	0.981	0.980	0.982
Flow Entry, veh/h	556	294	425
Cap Entry, veh/h	1155	977	1038
V/C Ratio	0.481	0.301	0.410
Control Delay, s/veh	8.4	6.8	7.9
LOS	A	A	A
95th %tile Queue, veh	3	1	2

Intersection			
Intersection Delay, s/veh	9.1		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	649	697	183
Demand Flow Rate, veh/h	662	711	187
Vehicles Circulating, veh/h	172	28	644
Vehicles Exiting, veh/h	567	803	190
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.2	8.4	8.3
Approach LOS	B	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	662	711	187
Cap Entry Lane, veh/h	1158	1341	715
Entry HV Adj Factor	0.981	0.981	0.979
Flow Entry, veh/h	649	697	183
Cap Entry, veh/h	1136	1315	700
V/C Ratio	0.572	0.530	0.261
Control Delay, s/veh	10.2	8.4	8.3
LOS	B	A	A
95th %tile Queue, veh	4	3	1

Intersection			
Intersection Delay, s/veh	13.5		
Intersection LOS	B		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	909	437	455
Demand Flow Rate, veh/h	927	445	464
Vehicles Circulating, veh/h	82	661	324
Vehicles Exiting, veh/h	706	348	782
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	13.9	16.9	9.3
Approach LOS	B	C	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	927	445	464
Cap Entry Lane, veh/h	1269	703	992
Entry HV Adj Factor	0.980	0.981	0.981
Flow Entry, veh/h	909	437	455
Cap Entry, veh/h	1244	690	972
V/C Ratio	0.730	0.633	0.468
Control Delay, s/veh	13.9	16.9	9.3
LOS	B	C	A
95th %tile Queue, veh	7	5	3

Intersection			
Intersection Delay, s/veh	5.4		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	321	428	172
Demand Flow Rate, veh/h	327	437	176
Vehicles Circulating, veh/h	78	31	313
Vehicles Exiting, veh/h	390	458	92
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.2	5.7	5.3
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	327	437	176
Cap Entry Lane, veh/h	1274	1337	1003
Entry HV Adj Factor	0.981	0.979	0.977
Flow Entry, veh/h	321	428	172
Cap Entry, veh/h	1250	1309	980
V/C Ratio	0.257	0.327	0.176
Control Delay, s/veh	5.2	5.7	5.3
LOS	A	A	A
95th %tile Queue, veh	1	1	1

Intersection			
Intersection Delay, s/veh	5.9		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	449	287	209
Demand Flow Rate, veh/h	458	293	213
Vehicles Circulating, veh/h	16	296	266
Vehicles Exiting, veh/h	463	178	323
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.8	6.5	5.4
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	458	293	213
Cap Entry Lane, veh/h	1358	1020	1052
Entry HV Adj Factor	0.980	0.979	0.981
Flow Entry, veh/h	449	287	209
Cap Entry, veh/h	1330	999	1032
V/C Ratio	0.337	0.287	0.202
Control Delay, s/veh	5.8	6.5	5.4
LOS	A	A	A
95th %tile Queue, veh	2	1	1

Intersection			
Intersection Delay, s/veh	7.4		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	466	659	151
Demand Flow Rate, veh/h	475	672	154
Vehicles Circulating, veh/h	168	15	452
Vehicles Exiting, veh/h	519	591	191
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.4	7.8	6.0
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	475	672	154
Cap Entry Lane, veh/h	1163	1359	870
Entry HV Adj Factor	0.981	0.981	0.981
Flow Entry, veh/h	466	659	151
Cap Entry, veh/h	1141	1333	853
V/C Ratio	0.409	0.495	0.177
Control Delay, s/veh	7.4	7.8	6.0
LOS	A	A	A
95th %tile Queue, veh	2	3	1

Intersection			
Intersection Delay, s/veh	8.0		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	608	398	381
Demand Flow Rate, veh/h	620	406	389
Vehicles Circulating, veh/h	35	348	337
Vehicles Exiting, veh/h	691	307	417
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.5	8.6	8.2
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	620	406	389
Cap Entry Lane, veh/h	1331	968	979
Entry HV Adj Factor	0.980	0.981	0.979
Flow Entry, veh/h	608	398	381
Cap Entry, veh/h	1305	949	958
V/C Ratio	0.466	0.420	0.398
Control Delay, s/veh	7.5	8.6	8.2
LOS	A	A	A
95th %tile Queue, veh	3	2	2

Intersection			
Intersection Delay, s/veh	11.3		
Intersection LOS	B		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	638	776	148
Demand Flow Rate, veh/h	651	792	151
Vehicles Circulating, veh/h	351	12	614
Vehicles Exiting, veh/h	453	753	388
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	14.7	9.3	7.3
Approach LOS	B	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	651	792	151
Cap Entry Lane, veh/h	965	1363	738
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	638	776	148
Cap Entry, veh/h	945	1336	723
V/C Ratio	0.675	0.581	0.205
Control Delay, s/veh	14.7	9.3	7.3
LOS	B	A	A
95th %tile Queue, veh	5	4	1

Intersection			
Intersection Delay, s/veh 11.6			
Intersection LOS B			
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	739	355	689
Demand Flow Rate, veh/h	753	362	703
Vehicles Circulating, veh/h	162	380	252
Vehicles Exiting, veh/h	793	535	490
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	11.8	8.3	13.1
Approach LOS	B	A	B
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	753	362	703
Cap Entry Lane, veh/h	1170	937	1067
Entry HV Adj Factor	0.981	0.981	0.980
Flow Entry, veh/h	739	355	689
Cap Entry, veh/h	1147	919	1046
V/C Ratio	0.644	0.387	0.659
Control Delay, s/veh	11.8	8.3	13.1
LOS	B	A	B
95th %tile Queue, veh	5	2	5

Intersection						
Int Delay, s/veh	2.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	85	0	115	140	0	11
Future Vol, veh/h	85	0	115	140	0	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	97	0	131	159	0	13

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	97	0	518 97
Stage 1	-	-	-	-	97 -
Stage 2	-	-	-	-	421 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1496	-	518 959
Stage 1	-	-	-	-	927 -
Stage 2	-	-	-	-	662 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1496	-	472 959
Mov Cap-2 Maneuver	-	-	-	-	472 -
Stage 1	-	-	-	-	927 -
Stage 2	-	-	-	-	604 -

Approach	EB	WB	NB
HCM Control Delay, s	0	3.4	8.8
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	959	-	-	1496	-
HCM Lane V/C Ratio	0.013	-	-	0.087	-
HCM Control Delay (s)	8.8	-	-	7.6	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0.3	-

Intersection			
Intersection Delay, s/veh	8.4		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	411	743	190
Demand Flow Rate, veh/h	419	758	193
Vehicles Circulating, veh/h	341	17	382
Vehicles Exiting, veh/h	434	558	378
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.7	8.9	6.0
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	419	758	193
Cap Entry Lane, veh/h	975	1356	935
Entry HV Adj Factor	0.980	0.980	0.984
Flow Entry, veh/h	411	743	190
Cap Entry, veh/h	955	1329	920
V/C Ratio	0.430	0.559	0.207
Control Delay, s/veh	8.7	8.9	6.0
LOS	A	A	A
95th %tile Queue, veh	2	4	1

Intersection			
Intersection Delay, s/veh	9.9		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	579	331	612
Demand Flow Rate, veh/h	591	338	624
Vehicles Circulating, veh/h	155	338	299
Vehicles Exiting, veh/h	768	408	377
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.7	7.5	12.2
Approach LOS	A	A	B
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	591	338	624
Cap Entry Lane, veh/h	1178	978	1017
Entry HV Adj Factor	0.980	0.980	0.981
Flow Entry, veh/h	579	331	612
Cap Entry, veh/h	1154	958	998
V/C Ratio	0.502	0.346	0.613
Control Delay, s/veh	8.7	7.5	12.2
LOS	A	A	B
95th %tile Queue, veh	3	2	4

Intersection						
Int Delay, s/veh	4.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	100	0	220	70	0	21
Future Vol, veh/h	100	0	220	70	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	114	0	250	80	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	114	0	694
Stage 1	-	-	-	-	114
Stage 2	-	-	-	-	580
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1475	-	409
Stage 1	-	-	-	-	911
Stage 2	-	-	-	-	560
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1475	-	340
Mov Cap-2 Maneuver	-	-	-	-	340
Stage 1	-	-	-	-	911
Stage 2	-	-	-	-	465

Approach	EB	WB	NB
HCM Control Delay, s	0	6	8.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	939	-	-	1475	-
HCM Lane V/C Ratio	0.025	-	-	0.169	-
HCM Control Delay (s)	8.9	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	-

Intersection			
Intersection Delay, s/veh	10.4		
Intersection LOS	B		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	651	712	359
Demand Flow Rate, veh/h	664	727	366
Vehicles Circulating, veh/h	188	46	644
Vehicles Exiting, veh/h	585	964	208
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.5	8.9	12.9
Approach LOS	B	A	B
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	664	727	366
Cap Entry Lane, veh/h	1139	1317	715
Entry HV Adj Factor	0.981	0.980	0.981
Flow Entry, veh/h	651	712	359
Cap Entry, veh/h	1117	1290	702
V/C Ratio	0.583	0.552	0.512
Control Delay, s/veh	10.5	8.9	12.9
LOS	B	A	B
95th %tile Queue, veh	4	4	3

Intersection			
Intersection Delay, s/veh20.0			
Intersection LOS C			
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1073	450	475
Demand Flow Rate, veh/h	1095	459	485
Vehicles Circulating, veh/h	84	801	333
Vehicles Exiting, veh/h	734	378	927
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	22.1	25.8	9.8
Approach LOS	C	D	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	1095	459	485
Cap Entry Lane, veh/h	1267	610	983
Entry HV Adj Factor	0.980	0.981	0.979
Flow Entry, veh/h	1073	450	475
Cap Entry, veh/h	1241	598	962
V/C Ratio	0.865	0.753	0.494
Control Delay, s/veh	22.1	25.8	9.8
LOS	C	D	A
95th %tile Queue, veh	12	7	3

Intersection						
Int Delay, s/veh	4.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	120	0	15	110	0	155
Future Vol, veh/h	120	0	15	110	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	136	0	17	125	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	136	0	295
Stage 1	-	-	-	-	136
Stage 2	-	-	-	-	159
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1448	-	696
Stage 1	-	-	-	-	890
Stage 2	-	-	-	-	870
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1448	-	688
Mov Cap-2 Maneuver	-	-	-	-	688
Stage 1	-	-	-	-	890
Stage 2	-	-	-	-	860

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	9.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	913	-	-	1448	-
HCM Lane V/C Ratio	0.193	-	-	0.012	-
HCM Control Delay (s)	9.9	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.7	-	-	0	-

Intersection			
Intersection Delay, s/veh	7.4		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	346	653	196
Demand Flow Rate, veh/h	353	666	200
Vehicles Circulating, veh/h	307	33	313
Vehicles Exiting, veh/h	392	480	347
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.3	8.0	5.6
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	353	666	200
Cap Entry Lane, veh/h	1009	1334	1003
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	346	653	196
Cap Entry, veh/h	989	1308	983
V/C Ratio	0.350	0.499	0.199
Control Delay, s/veh	7.3	8.0	5.6
LOS	A	A	A
95th %tile Queue, veh	2	3	1

Intersection			
Intersection Delay, s/veh	7.0		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	470	325	397
Demand Flow Rate, veh/h	479	332	405
Vehicles Circulating, veh/h	16	314	305
Vehicles Exiting, veh/h	694	181	341
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.9	7.1	8.0
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	479	332	405
Cap Entry Lane, veh/h	1358	1002	1011
Entry HV Adj Factor	0.981	0.979	0.980
Flow Entry, veh/h	470	325	397
Cap Entry, veh/h	1331	981	991
V/C Ratio	0.353	0.331	0.401
Control Delay, s/veh	5.9	7.1	8.0
LOS	A	A	A
95th %tile Queue, veh	2	1	2

Intersection						
Int Delay, s/veh	4.8					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	95	0	220	65	0	21
Future Vol, veh/h	95	0	220	65	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	108	0	250	74	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	108	0	682
Stage 1	-	-	-	-	108
Stage 2	-	-	-	-	574
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1483	-	415
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	563
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1483	-	345
Mov Cap-2 Maneuver	-	-	-	-	345
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	468

Approach	EB	WB	NB
HCM Control Delay, s	0	6.1	8.9
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	946	-	-	1483	-
HCM Lane V/C Ratio	0.025	-	-	0.169	-
HCM Control Delay (s)	8.9	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.6	-

Intersection			
Intersection Delay, s/veh	8.1		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	468	674	327
Demand Flow Rate, veh/h	478	688	334
Vehicles Circulating, veh/h	184	34	452
Vehicles Exiting, veh/h	538	752	209
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.6	8.2	8.8
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	478	688	334
Cap Entry Lane, veh/h	1144	1333	870
Entry HV Adj Factor	0.979	0.980	0.979
Flow Entry, veh/h	468	674	327
Cap Entry, veh/h	1120	1306	852
V/C Ratio	0.418	0.516	0.384
Control Delay, s/veh	7.6	8.2	8.8
LOS	A	A	A
95th %tile Queue, veh	2	3	2

Intersection			
Intersection Delay, s/veh	9.6		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	766	400	393
Demand Flow Rate, veh/h	781	408	401
Vehicles Circulating, veh/h	35	482	339
Vehicles Exiting, veh/h	705	334	551
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	9.5	10.8	8.4
Approach LOS	A	B	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	781	408	401
Cap Entry Lane, veh/h	1331	844	977
Entry HV Adj Factor	0.981	0.981	0.980
Flow Entry, veh/h	766	400	393
Cap Entry, veh/h	1306	828	957
V/C Ratio	0.587	0.483	0.411
Control Delay, s/veh	9.5	10.8	8.4
LOS	A	B	A
95th %tile Queue, veh	4	3	2

Intersection						
Int Delay, s/veh	4.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	105	0	15	100	0	155
Future Vol, veh/h	105	0	15	100	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	119	0	17	114	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	119	0	267
Stage 1	-	-	-	-	119
Stage 2	-	-	-	-	148
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1469	-	722
Stage 1	-	-	-	-	906
Stage 2	-	-	-	-	880
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1469	-	713
Mov Cap-2 Maneuver	-	-	-	-	713
Stage 1	-	-	-	-	906
Stage 2	-	-	-	-	869

Approach	EB	WB	NB
HCM Control Delay, s	0	1	9.8
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	933	-	-	1469	-
HCM Lane V/C Ratio	0.189	-	-	0.012	-
HCM Control Delay (s)	9.8	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.7	-	-	0	-

Intersection			
Intersection Delay, s/veh	11.3		
Intersection LOS	B		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	638	776	148
Demand Flow Rate, veh/h	651	792	151
Vehicles Circulating, veh/h	351	12	614
Vehicles Exiting, veh/h	453	753	388
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	14.7	9.3	7.3
Approach LOS	B	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	651	792	151
Cap Entry Lane, veh/h	965	1363	738
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	638	776	148
Cap Entry, veh/h	945	1336	723
V/C Ratio	0.675	0.581	0.205
Control Delay, s/veh	14.7	9.3	7.3
LOS	B	A	A
95th %tile Queue, veh	5	4	1

Intersection			
Intersection Delay, s/veh 11.6			
Intersection LOS B			
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	739	355	689
Demand Flow Rate, veh/h	753	362	703
Vehicles Circulating, veh/h	162	380	252
Vehicles Exiting, veh/h	793	535	490
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	11.8	8.3	13.1
Approach LOS	B	A	B
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	753	362	703
Cap Entry Lane, veh/h	1170	937	1067
Entry HV Adj Factor	0.981	0.981	0.980
Flow Entry, veh/h	739	355	689
Cap Entry, veh/h	1147	919	1046
V/C Ratio	0.644	0.387	0.659
Control Delay, s/veh	11.8	8.3	13.1
LOS	B	A	B
95th %tile Queue, veh	5	2	5

Intersection						
Int Delay, s/veh	2.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	85	0	115	140	0	11
Future Vol, veh/h	85	0	115	140	0	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	97	0	131	159	0	13

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	97	0	518
Stage 1	-	-	-	-	97
Stage 2	-	-	-	-	421
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1496	-	518
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	662
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1496	-	472
Mov Cap-2 Maneuver	-	-	-	-	472
Stage 1	-	-	-	-	927
Stage 2	-	-	-	-	604

Approach	EB	WB	NB
HCM Control Delay, s	0	3.4	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1496	-
HCM Lane V/C Ratio	-	-	-	0.087	-
HCM Control Delay (s)	0	-	-	7.6	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0.3	-

Intersection			
Intersection Delay, s/veh	8.4		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	411	743	190
Demand Flow Rate, veh/h	419	758	193
Vehicles Circulating, veh/h	341	17	382
Vehicles Exiting, veh/h	434	558	378
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.7	8.9	6.0
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	419	758	193
Cap Entry Lane, veh/h	975	1356	935
Entry HV Adj Factor	0.980	0.980	0.984
Flow Entry, veh/h	411	743	190
Cap Entry, veh/h	955	1329	920
V/C Ratio	0.430	0.559	0.207
Control Delay, s/veh	8.7	8.9	6.0
LOS	A	A	A
95th %tile Queue, veh	2	4	1

Intersection			
Intersection Delay, s/veh	9.9		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	579	331	612
Demand Flow Rate, veh/h	591	338	624
Vehicles Circulating, veh/h	155	338	299
Vehicles Exiting, veh/h	768	408	377
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	8.7	7.5	12.2
Approach LOS	A	A	B
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	591	338	624
Cap Entry Lane, veh/h	1178	978	1017
Entry HV Adj Factor	0.980	0.980	0.981
Flow Entry, veh/h	579	331	612
Cap Entry, veh/h	1154	958	998
V/C Ratio	0.502	0.346	0.613
Control Delay, s/veh	8.7	7.5	12.2
LOS	A	A	B
95th %tile Queue, veh	3	2	4

Intersection						
Int Delay, s/veh	4.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	100	0	220	70	0	21
Future Vol, veh/h	100	0	220	70	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	114	0	250	80	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	114	0	694
Stage 1	-	-	-	-	114
Stage 2	-	-	-	-	580
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1475	-	409
Stage 1	-	-	-	-	911
Stage 2	-	-	-	-	560
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1475	-	340
Mov Cap-2 Maneuver	-	-	-	-	340
Stage 1	-	-	-	-	911
Stage 2	-	-	-	-	465

Approach	EB	WB	NB
HCM Control Delay, s	0	6	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1475	-
HCM Lane V/C Ratio	-	-	-	0.169	-
HCM Control Delay (s)	0	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0.6	-

Intersection			
Intersection Delay, s/veh	10.4		
Intersection LOS	B		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	651	712	359
Demand Flow Rate, veh/h	664	727	366
Vehicles Circulating, veh/h	188	46	644
Vehicles Exiting, veh/h	585	964	208
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	10.5	8.9	12.9
Approach LOS	B	A	B
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	664	727	366
Cap Entry Lane, veh/h	1139	1317	715
Entry HV Adj Factor	0.981	0.980	0.981
Flow Entry, veh/h	651	712	359
Cap Entry, veh/h	1117	1290	702
V/C Ratio	0.583	0.552	0.512
Control Delay, s/veh	10.5	8.9	12.9
LOS	B	A	B
95th %tile Queue, veh	4	4	3

Intersection			
Intersection Delay, s/veh20.0			
Intersection LOS C			
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	1073	450	475
Demand Flow Rate, veh/h	1095	459	485
Vehicles Circulating, veh/h	84	801	333
Vehicles Exiting, veh/h	734	378	927
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	22.1	25.8	9.8
Approach LOS	C	D	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	1095	459	485
Cap Entry Lane, veh/h	1267	610	983
Entry HV Adj Factor	0.980	0.981	0.979
Flow Entry, veh/h	1073	450	475
Cap Entry, veh/h	1241	598	962
V/C Ratio	0.865	0.753	0.494
Control Delay, s/veh	22.1	25.8	9.8
LOS	C	D	A
95th %tile Queue, veh	12	7	3

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↶		↷	↶	↷	
Traffic Vol, veh/h	120	0	15	110	0	155
Future Vol, veh/h	120	0	15	110	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	136	0	17	125	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	136	0	295
Stage 1	-	-	-	-	136
Stage 2	-	-	-	-	159
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1448	-	696
Stage 1	-	-	-	-	890
Stage 2	-	-	-	-	870
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1448	-	688
Mov Cap-2 Maneuver	-	-	-	-	688
Stage 1	-	-	-	-	890
Stage 2	-	-	-	-	860

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1448	-
HCM Lane V/C Ratio	-	-	-	0.012	-
HCM Control Delay (s)	0	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-

Intersection			
Intersection Delay, s/veh	7.4		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	346	653	196
Demand Flow Rate, veh/h	353	666	200
Vehicles Circulating, veh/h	307	33	313
Vehicles Exiting, veh/h	392	480	347
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.3	8.0	5.6
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	353	666	200
Cap Entry Lane, veh/h	1009	1334	1003
Entry HV Adj Factor	0.980	0.980	0.980
Flow Entry, veh/h	346	653	196
Cap Entry, veh/h	989	1308	983
V/C Ratio	0.350	0.499	0.199
Control Delay, s/veh	7.3	8.0	5.6
LOS	A	A	A
95th %tile Queue, veh	2	3	1

Intersection			
Intersection Delay, s/veh	7.0		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	470	325	397
Demand Flow Rate, veh/h	479	332	405
Vehicles Circulating, veh/h	16	314	305
Vehicles Exiting, veh/h	694	181	341
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	5.9	7.1	8.0
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	479	332	405
Cap Entry Lane, veh/h	1358	1002	1011
Entry HV Adj Factor	0.981	0.979	0.980
Flow Entry, veh/h	470	325	397
Cap Entry, veh/h	1331	981	991
V/C Ratio	0.353	0.331	0.401
Control Delay, s/veh	5.9	7.1	8.0
LOS	A	A	A
95th %tile Queue, veh	2	1	2

Intersection						
Int Delay, s/veh	4.6					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	95	0	220	65	0	21
Future Vol, veh/h	95	0	220	65	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	108	0	250	74	0	24

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	108	0	682
Stage 1	-	-	-	-	108
Stage 2	-	-	-	-	574
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1483	-	415
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	563
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1483	-	345
Mov Cap-2 Maneuver	-	-	-	-	345
Stage 1	-	-	-	-	916
Stage 2	-	-	-	-	468

Approach	EB	WB	NB
HCM Control Delay, s	0	6.1	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1483	-
HCM Lane V/C Ratio	-	-	-	0.169	-
HCM Control Delay (s)	0	-	-	7.9	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0.6	-

Intersection			
Intersection Delay, s/veh	8.1		
Intersection LOS	A		
Approach	SE	NW	NE
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	468	674	327
Demand Flow Rate, veh/h	478	688	334
Vehicles Circulating, veh/h	184	34	452
Vehicles Exiting, veh/h	538	752	209
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	7.6	8.2	8.8
Approach LOS	A	A	A
Lane	Left	Left	Left
Designated Moves	TR	LT	LR
Assumed Moves	TR	LT	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	478	688	334
Cap Entry Lane, veh/h	1144	1333	870
Entry HV Adj Factor	0.979	0.980	0.979
Flow Entry, veh/h	468	674	327
Cap Entry, veh/h	1120	1306	852
V/C Ratio	0.418	0.516	0.384
Control Delay, s/veh	7.6	8.2	8.8
LOS	A	A	A
95th %tile Queue, veh	2	3	2

Intersection			
Intersection Delay, s/veh	9.6		
Intersection LOS	A		
Approach	SE	NW	SW
Entry Lanes	1	1	1
Conflicting Circle Lanes	1	1	1
Adj Approach Flow, veh/h	766	400	393
Demand Flow Rate, veh/h	781	408	401
Vehicles Circulating, veh/h	35	482	339
Vehicles Exiting, veh/h	705	334	551
Ped Vol Crossing Leg, #/h	0	0	0
Ped Cap Adj	1.000	1.000	1.000
Approach Delay, s/veh	9.5	10.8	8.4
Approach LOS	A	B	A
Lane	Left	Left	Left
Designated Moves	LT	TR	LR
Assumed Moves	LT	TR	LR
RT Channelized			
Lane Util	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976
Entry Flow, veh/h	781	408	401
Cap Entry Lane, veh/h	1331	844	977
Entry HV Adj Factor	0.981	0.981	0.980
Flow Entry, veh/h	766	400	393
Cap Entry, veh/h	1306	828	957
V/C Ratio	0.587	0.483	0.411
Control Delay, s/veh	9.5	10.8	8.4
LOS	A	B	A
95th %tile Queue, veh	4	3	2

Intersection						
Int Delay, s/veh	0.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻		↻	↑	↻	
Traffic Vol, veh/h	105	0	15	100	0	155
Future Vol, veh/h	105	0	15	100	0	155
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	0	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	119	0	17	114	0	176

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	119	0	267
Stage 1	-	-	-	-	119
Stage 2	-	-	-	-	148
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1469	-	722
Stage 1	-	-	-	-	906
Stage 2	-	-	-	-	880
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1469	-	713
Mov Cap-2 Maneuver	-	-	-	-	713
Stage 1	-	-	-	-	906
Stage 2	-	-	-	-	869

Approach	EB	WB	NB
HCM Control Delay, s	0	1	0
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	-	-	1469	-
HCM Lane V/C Ratio	-	-	-	0.012	-
HCM Control Delay (s)	0	-	-	7.5	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	-	-	-	0	-



Shadow Mountain Bike Park Sensory Impact Assessment - Noise

Final Report

March 21, 2023

Prepared for:
SE Group
323 W Main St.
Frisco CO 80443

Prepared by:
Stantec Consulting Services Inc.
733 Marquette Avenue, Suite 1000
Minneapolis, MN 55402

Project Number:
195602713

Limitations and Sign-off

The conclusions in this report Titled Shadow Mountain Bike Park Sensory Impact Assessment – Noise, are Stantec’s professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient’s own risk.

Stantec has assumed all information received from SE Group (the “Client”) and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec’s contract with the Client. While the Report may be provided to applicable authorities having jurisdiction and others for whom the Client is responsible, Stantec does not warrant the services to any third party. The report may not be relied upon by any other party without the express written consent of Stantec, which may be withheld at Stantec’s discretion.

Prepared by: _____
Signature
Samuel Arnold, P.Eng., MAsc.
Acoustical Engineer

Printed Name and Title

Reviewed by: _____
Signature
Jacob Poling, INCE
Senior Acoustician

Printed Name and Title

Approved by: _____
Signature
JoAnne Blank
Senior Associate Scientist

Printed Name and Title



Table of Contents

Limitations and Sign-off	i
Abbreviations	iii
Executive Summary	iv
1 Introduction	1
2 Noise Terminology	2
3 Facility Description	3
4 Noise Sources	4
5 Noise Sensitive Areas	5
6 Assessment Criteria	6
7 Methodology	7
7.1 Operational Noise Analysis	7
7.2 Construction Noise Assessment	9
7.2.1 Construction Noise Mitigation	10
8 Operational Noise Assessment	11
9 Conclusion	14

List of Tables

Table 5.1: Noise Sensitive Location Summary	5
Table 6.1: Jefferson County LDR Noise Criteria ¹	6
Table 7.1: Equipment Sound Power Levels	7
Table 7.2: Modelling Assumption Summary	8
Table 7.3: Construction Noise Limits	9
Table 7.4: Construction Equipment Noise Levels ¹	9
Table 8.1: Noise Impact Summary Table – LA ₂₅ Stationary Noise Sources	11
Table 8.2: Noise Impact Summary Table – LA ₀ Stationary Noise Sources	12
Table 8.3: Noise Impact Summary Table – LA ₀ Mobile Noise Sources	13

List of Agencies

Appendix A Figures

Figure A.1	Site Location Map
Figure A.2	NSA MAP
Figure A.3	Zoning Map
Figure A.4	Daytime Stationary Noise Contours LA ₂₅ 4.5 m AG (15 ft. aG)
Figure A.5	Nighttime Stationary Noise Contours LA ₂₅ 4.5 m AG (15 ft. Ag)
Figure A.6	Daytime Stationary Noise Contours LA ₀ 4.5 m AG (15 ft. Ag)
Figure A.7	Nighttime Stationary Noise Contours LA ₀ 4.5 m AG (15 ft. Ag)
Figure A.8	Daytime Mobile Noise Contours L ₀ 4.5 M AG (15 ft. AG)



Abbreviations

dB	Decibel
dBA	Decibel (A-weighted)
GA	Ground absorption
Hz	Hertz
ISO	International Standards Organization
L_{eq}	Equivalent continuous sound level
L_0	Sound level exceeded for 0% of the time
L_{10}	Sound level exceeded for 10% of the time
L_{25}	Sound level exceeded for 25% of the time
L_{50}	Sound level exceeded for 50% of the time
L_{90}	Sound level exceeded for 90% of the time
L_{max}	Maximum sound level
L_{min}	Minimum sound level
LDR	Land Development Regulations
SIA	Sensory Impact Assessment
SLM	Sound level meter
SMBP	Shadow Mountain Bike Park



Executive Summary

The SE Group has retained Stantec Consulting Services Inc. (Stantec) to complete a Sensory Impact Assessment (SIA) to evaluate noise impacts generated by the proposed Shadow Mountain Bike Park (SMBP). The proposed location of the SMBP is along Shadow Mountain Drive in Conifer, Jefferson County, Colorado (the Site). The proposed SMBP will consist of a downhill mountain bike park with lift services, 320 parking spaces, a day lodge building, and a maintenance building.

This SIA was completed in accordance with the requirements of the Jefferson County Colorado Land Development Regulation (LDR), amended December 6, 2022, which requires that proposed Developments not create sensory impacts including noise, odor, and visual impacts at nearby sensitive receptors such as parks, schools, or residential buildings. The scope of this SIA is limited to the evaluation of the impacts of noise resulting from the operation of the proposed SMBP only.

Operational noise from the SMBP was modelled using CADNA/A acoustic modelling software (version 2021 MR2) published by Datakustik GmbH, configured to implement ISO-9613-2 environmental noise propagation algorithms. Operational noise sources from Stantec's database were used for this assessment as final equipment selections and final design of the SMBP have yet to be completed at the time of writing of this report.

Stantec recommends that this study be updated when final design of the SMBP is complete to validate the assumptions of this SIA.

Predicted sound levels indicate that the noise generated by the proposed SMBP at nearby noise sensitive areas and highest impacted/worst case property line locations is below the applicable daytime and nighttime noise limits for nearby residential receptors. The results of this SIA demonstrate that the SMBP is expected to comply with the Jefferson County LDR noise limits.



1 Introduction

The SE Group has retained Stantec Consulting Services Inc. (Stantec) to complete a Sensory Impact Assessment (SIA) to evaluate noise impacts generated by the Shadow Mountain Bike Park (SMBP). The proposed location of the SMBP is along Shadow Mountain Drive in Conifer, Jefferson County, Colorado (The Site). The proposed SMBP will consist of a downhill mountain bike park with lift services, 320 parking spaces, a day lodge building, and a maintenance building.

This SIA was prepared in accordance with Section 26 of the Jefferson County Land Development Regulations (LDR) amended December 6, 2022.

Figure A.1 included in **Appendix A** shows the location of the Site.



2 Noise Terminology

Sound is caused by vibrations that generate waves of minute pressure fluctuations in the surrounding air. Sound levels are measured using a logarithmic decibel (dB) scale. Human hearing varies in sensitivity for different sound frequencies, and the frequency sensitivity changes based on the overall sound level. The ear is most sensitive to sound at frequencies between 800 and 8,000 hertz (Hz) and is least sensitive to sound at frequencies below 400 Hz or above 12,500 Hz. Consequently, several different frequency weighting schemes have been used to approximate the way the human ear responds to various frequencies at different sound levels. The A-weighted decibel, or dBA, scale is the most widely used for regulatory requirements, as it discriminates against low frequency noise similar to the response of the human ear at the low to moderate sound levels typical of environmental sources. Sound levels without a frequency weighting applied, referred to as unweighted or linear, are generally reported as dB or dBZ.

The sound power level (PWL or L_w) of a noise source is the strength or intensity of noise that the source emits regardless of the environment in which it is placed. Sound power is a property of the source, and therefore is independent of distance. The radiating sound power then produces a sound pressure level (SPL or L_p) at a point of which human beings can perceive as audible sound. The sound pressure level is dependent on the acoustical environment (e.g., indoor, outdoor, absorption, reflections) and the distance from the noise source. Unless otherwise stated, sound levels in this report are sound pressure levels.

Numerous metrics and indices have been developed to quantify the temporal characteristics (changes over time) of community noise. The equivalent continuous sound level, L_{eq} , metric is the level of a hypothetical steady sound that would have the same energy as the fluctuating sound level over a defined period of time. The L_{eq} represents the time average of the fluctuating sound pressure level. The maximum and minimum sound levels, or L_{max} and L_{min} , are the loudest and quietest instantaneous sound levels occurring during a period of time. The L_{max} is particularly useful for evaluating loud, impulsive noise events.

Other statistical metrics useful to understanding environmental sound levels include the n-percent exceedance sound percentile levels, or L_n . This report includes the L_{25} metric, or the noise level that is exceeded 25% of the time and the L_0 which is the sound level exceeded 0% of the time. The L_0 can be considered equivalent to the L_{max} or maximum sound level. The L_{10} can be approximated as the sound level between L_{max} and L_{25} .

A change in sound levels of 3 decibels is generally considered to be the threshold of perception, whereas a change of 5 decibels is clearly perceptible, and a change of 10 decibels is perceived as a doubling or halving of loudness.



3 Facility Description

The proposed SMBP will consist of a four-passenger chairlift to transport guests and bikes to the top terminal area for gravity flow and downhill trails. The SMBP will operate during daytime hours, as defined by Section 26 of the Jefferson County LDR, between 7 a.m. to 7 p.m. The chairlift will require one terminal in the base area and the terminal area at the top of Shadow Mountain. Chairlift construction will require a 40-foot-wide corridor to accommodate the associated infrastructure. The corridor will be cleared during the construction phase of the project. The chairlift will require power at the bottom and top terminal areas as well as communication lines along the lift infrastructure.

The SMBP will provide approximately 16 miles of trails with varying levels of difficulty. Trails will be constructed of earth, wood, steel, and other materials. All trails will be setback a minimum of 50 feet from property lines.

Parking for approximately 300 guest vehicles will be provided near the base area using the access road along Shadow Mountain Drive. A day lodge will be constructed in the base area of the SMBP to provide guest services including indoor seating, ticketing, restrooms, changing rooms, bike and equipment rentals, and outdoor guest space and seating. Water will be supplied by a commercial water well and sewage will be handled by an onsite wastewater system.

There will be no permanent kitchen space in the day lodge. To address the food and beverage needs of guests, food truck vendors will be brought on site during operational hours.

A maintenance building will be constructed along the maintenance access road for facility operations. Parking for approximately 20 employees will be provided adjacent to the maintenance building.



4 Noise Sources

Based on the facility description, the primary sources of noise from the SMBP are assumed to be the following:

- Chairlift terminals at the base area and top of Shadow Mountain.
- HVAC equipment at the day lodge, maintenance building, and chairlift buildings.
- Vehicle noise from movements in the parking lot.
- Vehicle noise along the maintenance road from the maintenance shop to the mountain top.
- Speakers near the day lodge outside dining area.
- A food truck idling adjacent to the day lodge.

The primary noise sources expected to operate at the proposed SMBP are consistent with the definition of steady state or quasi steady state impulsive sound. Steady state or quasi steady state impulsive sound can generally be defined as a sequence of impulsive sound emitted from the same source having a time interval of less than 0.5 seconds between successive impulsive sounds. Impulsive sound can be generally defined as a single pressure pulse or a single burst of pressure pulses with a time interval of equal or greater than 0.5 seconds. Examples of impulsive sound can include dump truck gate banging or impact pile driver operation.

Other potential sources of noise on site such as human or electric powered mountain bikes travelling along the proposed SMBP trails or noise along the chairlift line are assumed to have an insignificant impact to nearby sensitive noise receptors.



5 Noise Sensitive Areas

Noise sensitive areas (NSAs) were identified around the SMBP based on a review of satellite imagery and zoning. Thirteen NSA locations were selected to evaluate the noise impact from steady state noise SMBP sources at residences. Five (5) additional locations were selected near the property lines of the Site as representative worst-case locations. Property line locations were assessed 25 feet from the property limits of the proposed SMBP consistent with the evaluation requirements of the Jefferson County LDR. A summary of NSAs is provided in **Table 5.1**. A location map of NSAs is included as **Figure A.2** in **Appendix A**. A zoning map for the area surrounding the site is included as **Figure A.3** in **Appendix A**.

Table 5.1: Noise Sensitive Location Summary

Noise Sensitive Area ID	Description and Approximate Street Address ¹	UTM NAD 83 Coordinates		
		Zone	Easting	Northing
NSA01	Residence at 30812 Shadow Mountain Drive	13S	469462	4376303
NSA02	Residence at 10188 Christopher Drive	13S	469795	4375463
NSA03	Residence at 10178 Christopher Drive	13S	469781	4375299
NSA04	Residence at 10218 Christopher Drive	13S	469621	4375781
NSA05	Residence at 29795 Kennedy Gulch Road	13S	470473	4374826
NSA06	Residence at 30241 Shadow Mountain Drive	13S	470491	4376172
NSA07	Residence at 29611 Shadow Mountain Drive	13S	470742	4375981
NSA08	Residence at 29365 Kennedy Gulch Road	13S	471070	4375165
NSA09	Residence at 30772 Shadow Mountain Drive	13S	469711	4376453
NSA10	Residence at 30192 Shadow Mountain Drive	13S	470205	4376076
NSA11	Residence at 29455 Kennedy Gulch Road	13S	470684	4374893
NSA12	Residence at 29405 Kennedy Gulch Road	13S	470988	4374980
NSA13	Residence at 29152 Shadow Mountain Drive	13S	471269	4375568
NSA14	25 ft. from West Property Line	13S	469810	4375391
NSA15	25 ft. from North Property Line	13S	470170	4376056
NSA16 ²	50 ft. from Northeast Property Line	13S	470456	4376057
NSA17	25 ft. from East Property Line	13S	470525	4375820
NSA18	25 ft. from East Property Line	13S	470523	4375937

¹ All residences conservatively assumed to be two-story residences. Property line assessment height assumed to be one story.

² NSA16 has been assessed at approximately 50 ft. from the northeast property line as 25 ft. from the northeast property line is in the center of Shadow Mountain Drive within the public right-of-way. The assessment point at 50 ft. from the northeast property line is located along a pathway which is more representative of a noise sensitive assessment location.



6 Assessment Criteria

The December 6, 2022, revision of the Jefferson County, Colorado LDR regulates the development of lands in the County with consideration given to protecting land, environment, and natural resources. Section 26 of the LDR regulates sensory impacts from a Development which can include noise, odor, and visual impacts. This assessment is limited to assessing the noise impact of the proposed SMBP.

The applicable criteria for the project under Section 4, Subsection A is:

“Noise generated from the proposed development shall not exceed the dBA levels set forth in Section 25-12-103, C.R.S. or as may be amended from time to time. The dBA levels are depicted in the dBA Table: (reloc. 7-12-05; am. 4-4-06)”

The table referenced in the LDR is provided as **Table 6.1**.

Table 6.1: Jefferson County LDR Noise Criteria¹

dBA Table					
Time	7 a.m. to 7 p.m.	7 a.m. to 7 p.m.	7 a.m. to 7 p.m.	7 p.m. to 7 a.m.	7 p.m. to 7 a.m.
Frequency	L ₂₅	L ₀	Periodic/Impulsive	L ₀	Periodic/Impulsive
Park/School, Residential	55	65	50	50	45
Commercial	60	70	55	55	50
Light Industrial	70	80	65	65	60
Industrial	80	90	75	75	70

¹ Source Jefferson County Colorado Land Development Regulation December 2022

The area surrounding the proposed SMBP is zoned primarily residential or agricultural with existing residences. Stantec has adopted the steady state (i.e., non-periodic/impulsive) noise limits for residential areas and property line evaluation locations for this assessment. The applicable limits for residential areas are L₂₅ of 55 dBA or L₀ of 65 dBA during daytime hours and L₀ of 50 dBA during nighttime hours for steady state noise sources measured 25 ft. from the property limits of the SMBP.

The SMBP is not expected to have any significant sources of periodic or impulsive noise and operations will be limited to daytime hours only, with the exception of HVAC units. The L₁₀ noise level of a noise source can typically be estimated by adding 3 dBA to the LA_{eq} noise level¹ and, by definition, the L₂₅ noise level for a piece of equipment will be lower than the L₁₀ noise level. For this study, the L₂₅ noise level was conservatively estimated by adding a 3 dBA correction factor to modelled LA_{eq} noise levels. The L₀ noise level, which is higher than both the L₁₀ and L₂₅, was conservatively estimated by adding a 6 dBA correction factor to modelled LA_{eq} noise levels.

¹ Federal Highway Administration Roadway Construction Noise Model (RCNM) User's Guide. January 2006.



7 Methodology

7.1 Operational Noise Analysis

The proposed SMBP will include several sources of steady state noise as described in **Section 4**. As final equipment selections have not been completed at the time of writing of this report, Stantec has selected representative sound power levels to model the predicted impact of the SMBP.

The representative equipment sound power levels used in the analysis are summarized in **Table 7.1**.

Table 7.1: Equipment Sound Power Levels

Equipment Type	Type	Octave Band Sound Power Level (dB)									Total Sound Power Level (dBA)
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	
Chair Lift Terminal	Leq	73	78	93	90	93	88	96	83	78	98
Vehicle Passby	Lmax	64	59	65	58	55	54	50	45	40	90
HVAC Unit	Leq	85	86	82	78	76	73	69	64	56	78
Truck Idle	Leq	30	94	96	94	88	85	81	78	74	91
Speaker	Leq	86	93	91	86	90	95	91	87	81	98



Table 7.2 summarizes the modelling assumptions used for equipment quantities, operating parameters including speed and operating time, and other modelling parameters.

Table 7.2: Modelling Assumption Summary

Equipment Type	Quantity	Operation Time	Operational Notes
Chair Lift Terminal	2	7 a.m. to 7 p.m.	Operations at the top terminal area and at the base terminal area. Operating continuously during daytime hours only. Top terminal area to be located 150 ft. from west property line.
Transport Truck	1	7 a.m. to 7 p.m.	One truck per hour along the maintenance road connecting the top terminal to the maintenance building. Speed assumed to be 10 mph and operating during daytime hours only.
HVAC Unit	6	24-hour operation	One HVAC unit at the top terminal chairlift, one at the bottom terminal chairlift, two at the day lodge building, and two at the maintenance building. All operating continuously over a 24-hour period
Truck Idle	1	7 a.m. to 7 p.m.	One food truck idling along the southwest side of the lodge building operating continuously during daytime hours only.
Speaker	1	7 a.m. to 7 p.m.	One speaker adjacent to the outdoor seating area at the southwest side of the lodge building operating continuously during daytime hours only
Vehicle Parking Noise	241	7 a.m. to 7 p.m.	A worst case 241 vehicles per hour entering and exiting the site in the parking lot area has been assumed.

Noise modeling was completed using the Datakustik CadnaA environmental noise modeling software. The operational noise modeling followed typical modeling standards, input parameters, and assumptions, namely:

- The ISO 9613-2 standard² algorithm for outdoor sound propagation was used.
- Ground absorption factor of G=0.8 was used.
- Ground elevations were included in the model using equal height contour lines.
- Meteorology parameters were set to 10 degrees Celsius and 70 percent relative humidity.
- Receptor height of 4.5 m (15 ft.) to be representative of a two-storey residence.
- No sound attenuation from vegetation (foliage) to simulate a worst-case condition when leaves have fallen off trees.
- Meteorological conditions are conducive to sound propagation with all receptors located downwind of all noise sources.

² ISO 9613-2: 1996. Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation.



7.2 Construction Noise Assessment

Construction activities related to the Development of the proposed SMBP will occur in phases and generally consist of site preparation including tree clearing and road construction, installation of the chair lift, construction of the lodge, and installation of utilities. Construction activities will typically be limited to daytime only.

In accordance with the Jefferson County Regulatory Policy – Noise Abatement adopted April 24, 2007 (*Policy No. Part 3, Regulations, Chapter 1, Noise, Section 1*) construction activities are subject to the noise limits summarized in **Table 7.3**.

Table 7.3: Construction Noise Limits

Time Period	Limits ¹
7 a.m. to 7 p.m.	80 dB(A)
7 p.m. to 7 a.m.	75 dB(A)

¹ Noise limits are applicable 25 ft. from the property line of the Development.

At this stage of the proposed SMBP development, detailed construction phasing including equipment selections and timelines have not been finalized. In general, noise impacts from construction equipment will vary by type, age of equipment, overall condition, and operators. During construction of the proposed SMBP, noise from construction activities may be audible at nearby sensitive receptors; however, not all construction equipment required for the construction of the SMBP will be operating at the same time. Additionally, activities will be spread across the Project area and be temporary in duration which will reduce the overall noise impact of construction activities.

The minimum setback distance of noise sensitive areas identified in **Section 5** is approximately 200 feet from major project components such as the chairlift, parking lot, and day lodge. A summary of representative noise levels for anticipated construction equipment is provided in Table 7.4 at 50 ft. Maximum sound levels from equipment is expected to be below the applicable construction noise limits identified in **Table 7.3**; however, Stantec recommends that the construction equipment list and setback distances be reviewed and confirmed prior to construction.

Table 7.4: Construction Equipment Noise Levels¹

Equipment	Noise Level at 50 feet from Source (dBA L _{max})	Noise Level at 200 feet from Source (dBA L _{max})
Bulldozer	85	73
Crane	85	73
Chainsaw	85	73
Excavator	81	69
Front end loader	79	67
Concrete batch plant	83	71
Drill Rig Truck	79	67



Equipment	Noise Level at 50 feet from Source (dBA L _{max})	Noise Level at 200 feet from Source (dBA L _{max})
Grader	85	73
Haul/Dump Truck	84	72
Flat Bed Truck	74	62
Pneumatic Tools	85	73
Backhoe	80	68

¹ Source: Federal Highway Administration Roadway Construction Noise Model (RCNM) User's Guide. January 2006.

7.2.1 Construction Noise Mitigation

Construction noise is typically mitigated by implementing best practices such as ensuring construction equipment and associated mufflers are in good working order, limiting the loudest construction activities to daytime hours, using alternative quieter construction methods and/or scheduling work to minimize concurrent use of the loudest equipment, and establishing a noise complaint resolution process. Placement of noise barriers around work sites can be considered for activities in the near vicinity of noise-sensitive land uses.



8 Operational Noise Assessment

Operational noise modelling was completed for the proposed SMBP with the modelling assumptions and methodology outlined in **Section 7.1**. With the exception of HVAC equipment, on-site noise sources will operate during daytime hours only. Due to the varying nature of vehicle passbys as they travel along a modelled path, Stantec has conservatively evaluated vehicle passbys using the LA₀ noise metric. As all other sources of noise are stationary, they have been evaluated using the LA₂₅ noise metric.

Predicted project-generated noise levels at the noise sensitive areas and property lines are summarized in **Table 8.1** and **Table 8.2** for stationary noise sources. Predicted project-generated noise levels at the noise sensitive areas and representative property line locations are summarized in **Table 8.3** for mobile noise sources. Mobile noise source impacts were evaluated as a result of vehicle passbys along the maintenance road and parking lot. The LA₂₅ is the noise level exceeded 25 percent of the time and the LA₀ is the maximum noise level.

Table 8.1: Noise Impact Summary Table – LA₂₅ Stationary Noise Sources

Noise Sensitive Area ID	Description	Daytime Project Noise Level (LA ₂₅ dBA) ¹	Nighttime Project Noise Level (LA ₂₅ dBA) ¹	Day Limit (LA ₂₅ dBA) ¹	Night Limit (LA ₂₅ dBA) ¹	Complies with Limits?
NSA01	Residence at 30812 Shadow Mountain Drive	25	13	55	-	Yes
NSA02	Residence at 10188 Christopher Drive	50	31	55	-	Yes
NSA03	Residence at 10178 Christopher Drive	41	24	55	-	Yes
NSA04	Residence at 10218 Christopher Drive	32	20	55	-	Yes
NSA05	Residence at 29795 Kennedy Gulch Road	22	10	55	-	Yes
NSA06	Residence at 30241 Shadow Mountain Drive	45	27	55	-	Yes
NSA07	Residence at 29611 Shadow Mountain Drive	40	23	55	-	Yes
NSA08	Residence at 29365 Kennedy Gulch Road	27	13	55	-	Yes
NSA09	Residence at 30772 Shadow Mountain Drive	31	20	55	-	Yes
NSA10	Residence at 30192 Shadow Mountain Drive	45	33	55	-	Yes
NSA11	Residence at 29455 Kennedy Gulch Road	27	14	55	-	Yes
NSA12	Residence at 29405 Kennedy Gulch Road	26	12	55	-	Yes
NSA13	Residence at 29152 Shadow Mountain Drive	31	16	55	-	Yes
NSA14	25 ft. from West Property Line	55	36	55	-	Yes
NSA15	25 ft. from North Property Line	44	34	55	-	Yes
NSA16	50 ft. from Northeast Property Line	53	32	55	-	Yes
NSA17	25 ft. from East Property Line	50	31	55	-	Yes
NSA18	25 ft. from East Property Line	53	31	55	-	Yes

¹ LA₂₅ estimated based on LA_{eq} sound level with +3 dBA correction factor.



Shadow Mountain Bike Park Sensory Impact Assessment - Noise

8 Operational Noise Assessment

March 21, 2023

Table 8.2: Noise Impact Summary Table – LA₀ Stationary Noise Sources

Noise Sensitive Area ID	Description	Daytime Project Noise Level (LA ₀ dBA) ¹	Nighttime Project Noise Level (LA ₀ dBA) ¹	Day Limit (LA ₀ dBA) ¹	Night Limit (LA ₀ dBA) ¹	Complies with Limits?
NSA01	Residence at 30812 Shadow Mountain Drive	27	16	65	50	Yes
NSA02	Residence at 10188 Christopher Drive	53	34	65	50	Yes
NSA03	Residence at 10178 Christopher Drive	44	27	65	50	Yes
NSA04	Residence at 10218 Christopher Drive	34	23	65	50	Yes
NSA05	Residence at 29795 Kennedy Gulch Road	24	12	65	50	Yes
NSA06	Residence at 30241 Shadow Mountain Drive	48	30	65	50	Yes
NSA07	Residence at 29611 Shadow Mountain Drive	43	26	65	50	Yes
NSA08	Residence at 29365 Kennedy Gulch Road	30	15	65	50	Yes
NSA09	Residence at 30772 Shadow Mountain Drive	34	23	65	50	Yes
NSA10	Residence at 30192 Shadow Mountain Drive	48	36	65	50	Yes
NSA11	Residence at 29455 Kennedy Gulch Road	29	15	65	50	Yes
NSA12	Residence at 29405 Kennedy Gulch Road	29	14	65	50	Yes
NSA13	Residence at 29152 Shadow Mountain Drive	33	18	65	50	Yes
NSA14	25 ft. from West Property Line	58	38	65	50	Yes
NSA15	25 ft. from North Property Line	46	36	65	50	Yes
NSA16	50 ft. from Northeast Property Line	54	35	65	50	Yes
NSA17	25 ft. from East Property Line	53	34	65	50	Yes
NSA18	25 ft. from East Property Line	54	34	65	50	Yes

¹ LA₀ estimated based on LA_{eq} sound level with +6 dBA correction factor.



Table 8.3: Noise Impact Summary Table – LA₀ Mobile Noise Sources

Noise Sensitive Area ID	Description	Daytime Project Noise Level (LA ₀ dBA) ¹	Nighttime Project Noise Level (LA ₀ dBA) ¹	Day Limit (LA ₀ dBA) ¹	Night Limit (LA ₀ dBA) ¹	Complies with Limits?
NSA01	Residence at 30812 Shadow Mountain Drive	20	-	65	50	Yes
NSA02	Residence at 10188 Christopher Drive	49	-	65	50	Yes
NSA03	Residence at 10178 Christopher Drive	39	-	65	50	Yes
NSA04	Residence at 10218 Christopher Drive	28	-	65	50	Yes
NSA05	Residence at 29795 Kennedy Gulch Road	27	-	65	50	Yes
NSA06	Residence at 30241 Shadow Mountain Drive	35	-	65	50	Yes
NSA07	Residence at 29611 Shadow Mountain Drive	31	-	65	50	Yes
NSA08	Residence at 29365 Kennedy Gulch Road	19	-	65	50	Yes
NSA09	Residence at 30772 Shadow Mountain Drive	27	-	65	50	Yes
NSA10	Residence at 30192 Shadow Mountain Drive	46	-	65	50	Yes
NSA11	Residence at 29455 Kennedy Gulch Road	26	-	65	50	Yes
NSA12	Residence at 29405 Kennedy Gulch Road	20	-	65	50	Yes
NSA13	Residence at 29152 Shadow Mountain Drive	20	-	65	50	Yes
NSA14	25 ft. from West Property Line	52	-	65	50	Yes
NSA15	25 ft. from North Property Line	56	-	65	50	Yes
NSA16	50 ft. from Northeast Property Line	56	-	65	50	Yes
NSA17	25 ft. from East Property Line	38	-	65	50	Yes
NSA18	25 ft. from East Property Line	54	-	65	50	Yes

¹ LA₀ estimated based on LA_{eq} sound level with +6 dBA correction factor.

The above tables demonstrate that Project sound levels are predicted to be below the applicable daytime and nighttime noise criteria at all nearby existing sensitive receptors and 25 feet from the property line of the SMBP for NSA14, NSA15, NSA17, and NSA18.

The noise level at NSA16, representing the northeast property line, was assessed using a setback distance of 50 ft. rather than 25 ft. The location that is 25 ft. from the property line is situated at the center of Shadow Mountain Drive, which is not a noise sensitive location. The 50 ft. setback distance situates NSA16 along the pathway on the north side of Shadow Mountain drive which is a more representative noise sensitive location.

Stationary sound level contours at 15 feet above ground are presented in **Figure A.4** and **Figure A.5** for LA₂₅ noise levels and **Figure A.6** and **Figure A.7** for L₀ noise levels in **Appendix A**. Mobile sound level contours at 15 ft above ground from vehicle passbys are presented as **Figure A.8** in **Appendix A**. The sound level contours illustrate how sound is expected to propagate in the area surrounding the Project and account for the effects of local site topography. The sound level contours further show that Project noise levels are below the applicable limits at nearby receptors and at locations 25 feet from the property line of the proposed SMBP.



9 Conclusion

This sensory impact assessment was completed to evaluate the noise impact of the proposed Shadow Mountain Bike Park the Jefferson County Land Development Regulations. An operational noise model was developed and used to predict the noise impacts of proposed equipment on the Site.

The results of the noise modelling for operational noise predict that noise levels at the nearby sensitive noise receivers will comply with the Jefferson County requirements.

Additionally, construction noise impacts from equipment predicted to be required for the construction of the Shadow Mountain Bike Park are expected to be below the applicable construction noise limits.

This assessment was completed using the preliminary site layout and equipment locations provided by the SE group. Locations of equipment and equipment selection may change and additional construction equipment, not considered in this assessment, such as impact pile drivers may be required during construction. Stantec recommends that this study be updated when final design is completed to evaluate compliance with applicable noise criteria and validate the assumptions made for this assessment.



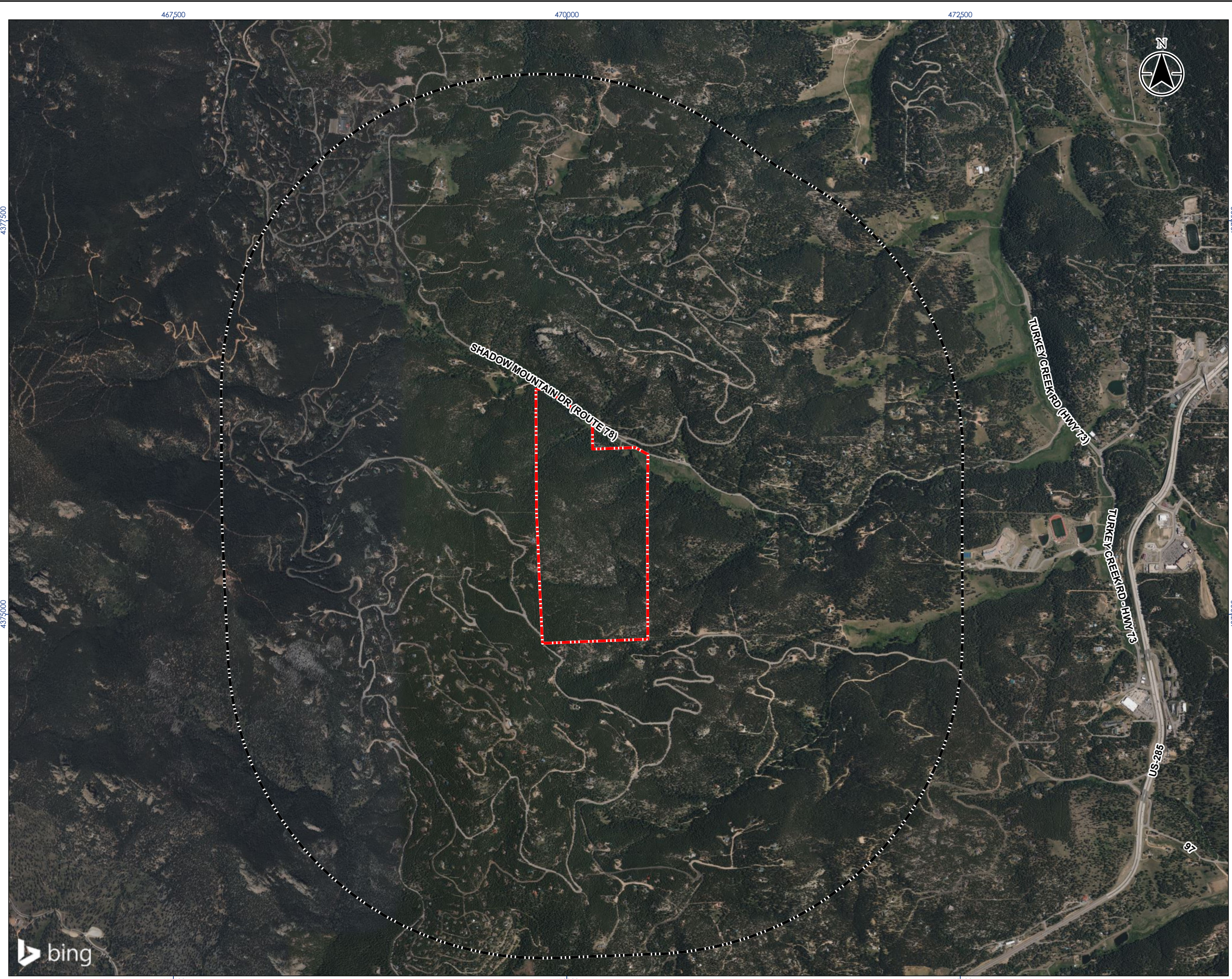
Appendices



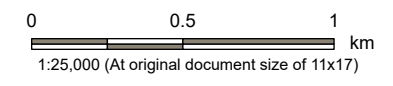
Appendix A Figures



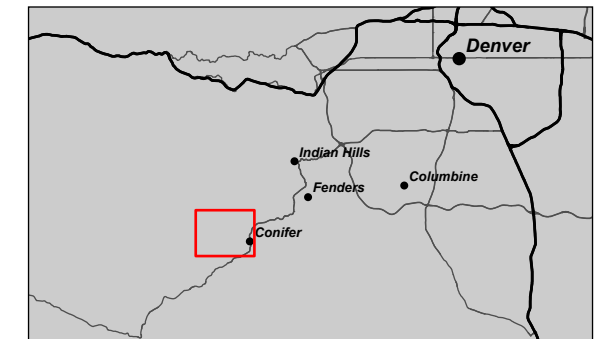
\\va0004-ppes\sw\work_group\01609\active\Other_POC_Active\009_G01811248\03_data\figs\emr\noise\report_figures\noise_1811248_nose_is_spr\1811248_fig01_SitePlan_Reviewed: 2024-03-20 By: malcazaren



- Legend
- Site Limits
 - Site Limits (2km buffer)



- Notes
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



Project Location: 18171248 REVA
 Jefferson County, CO Prepared by MDA on 2024-03-20
 Technical Review by BCC on 2023-11-30

Client/Project
 SE Group
 Shadow Mountain Sensory Impact Study - Noise

Figure No.

A.1

Title
Site Plan





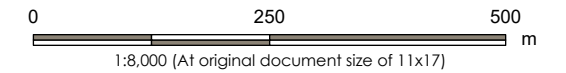
470000

471000

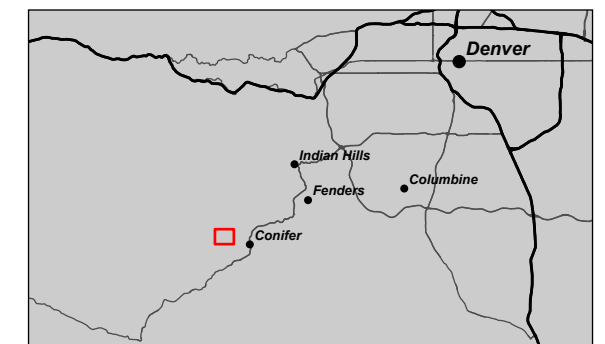


Legend

-  Site Limits
-  Noise Receptor



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



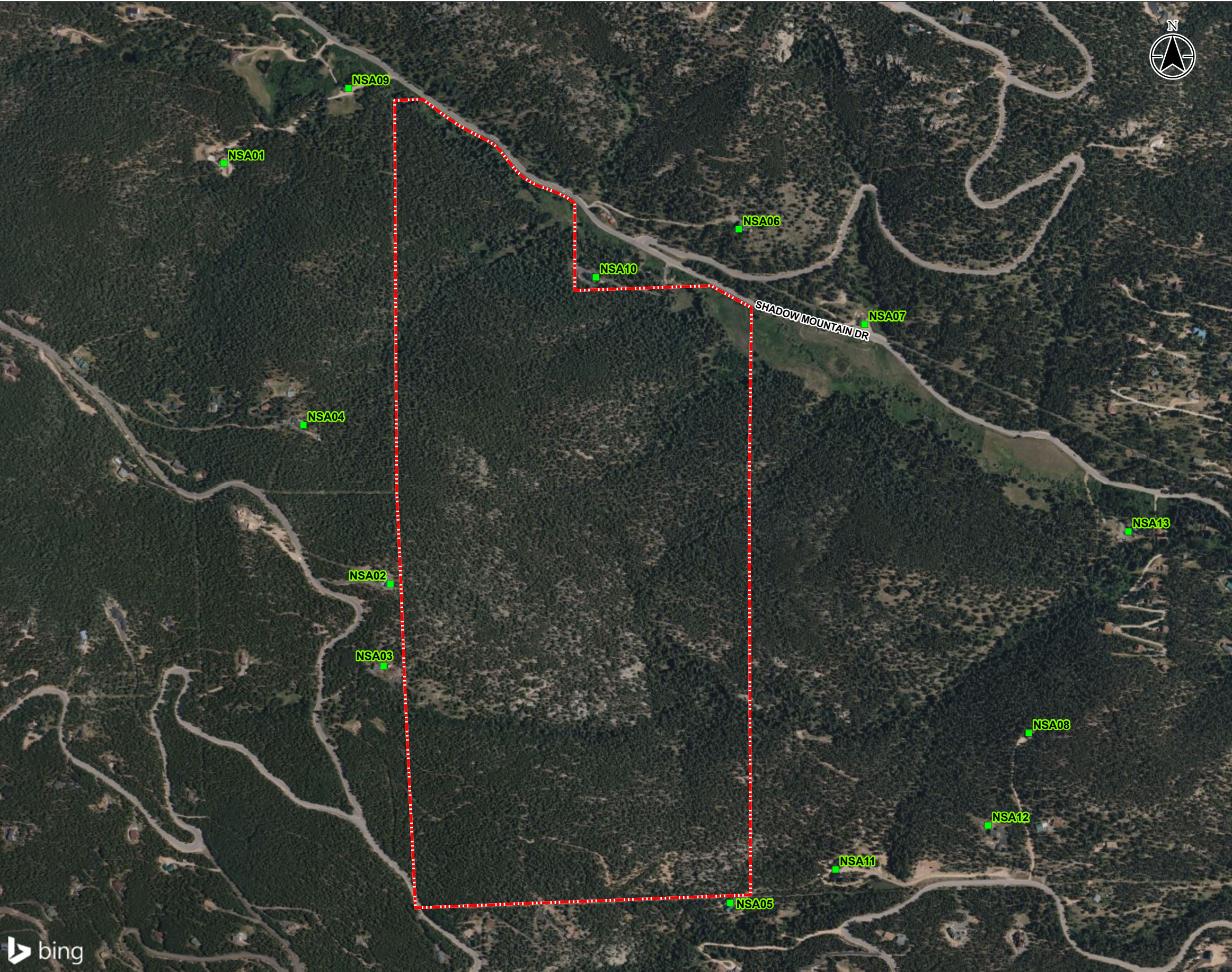
Project Location: 181711248 REVA
 Jefferson County, CO Prepared by MDA on 2024-03-20
 Technical Review by BCC on 2023-11-30

Client/Project:
 SE Group
 Shadow Mountain Sensory Impact Study - Noise

Figure No.
A.2
 Title
Noise Source Plan

470000

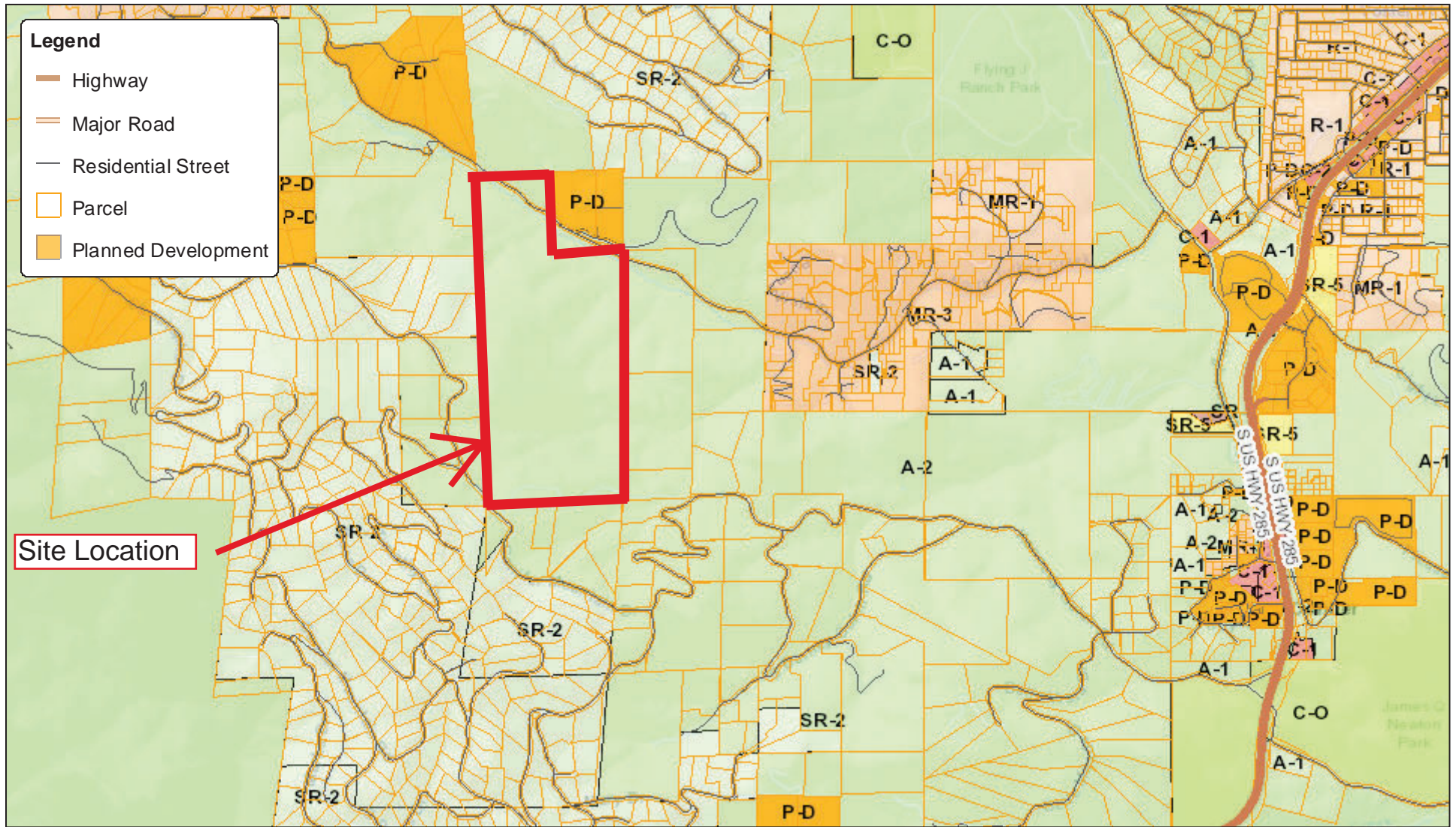
471000



\\va0004-ppes\work_group\01609\active_Other_PCo_Active\009_GIS\181711248\03_data\gis\smx\noise\report_figures\noise_181711248_noise_181711248_fig02_NSPan
 Reviewed: 2024-03-20 By: malcazaren
 4375000
 4375000



Jefferson County, Colorado



Site Location



Jefferson County offers this service for informational purposes only for the convenience of the user and assumes no liability whatsoever associated with the use or misuse of this data. This data is provided "as is" and Jefferson County disclaims all representations and warranties expressed or implied, including without limitation all representations and warranties as to the completeness, accuracy, correctness, merchantability and fitness for a particular purpose of any data and any and all warranties of title related thereto.

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Author: ArcGIS Web AppBuilder
Date: 11/27/2023






Figure A.3 Zoning Map

470000

471000



Legend

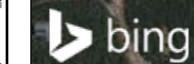
-  Site Limit
-  Noise Receptor
-  Point Source
-  Line Source
-  Daytime Noise Contour 4.5m (15ft.) AG

4375000

4375000

4375000

4375000

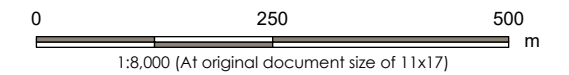


470000

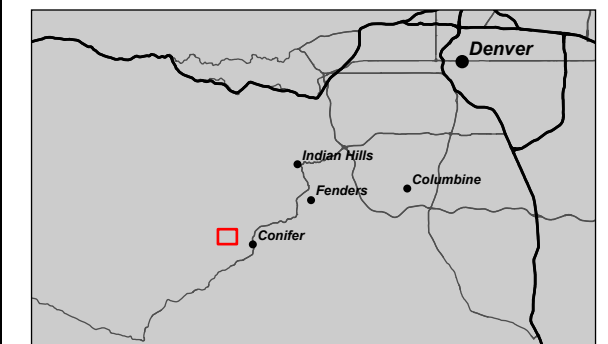
471000

4376000

4376000



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



Project Location: Jefferson County, CO
 Prepared by MDA on 2024-03-19
 Technical Review by BCC on 2023-11-30

Client/Project:
 SE Group
 Shadow Mountain Sensory Impact Study - Noise






Figure No.
A.4
 Title
**Daytime Stationary Noise Contour LA₂₅
 4.5m (15 ft. AG)**

470000

471000



Legend

-  Site Limit
-  Noise Receptor
-  Point Source
-  Line Source
-  Nighttime Noise Contour 4.5m (15 ft.) AG

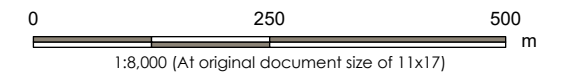
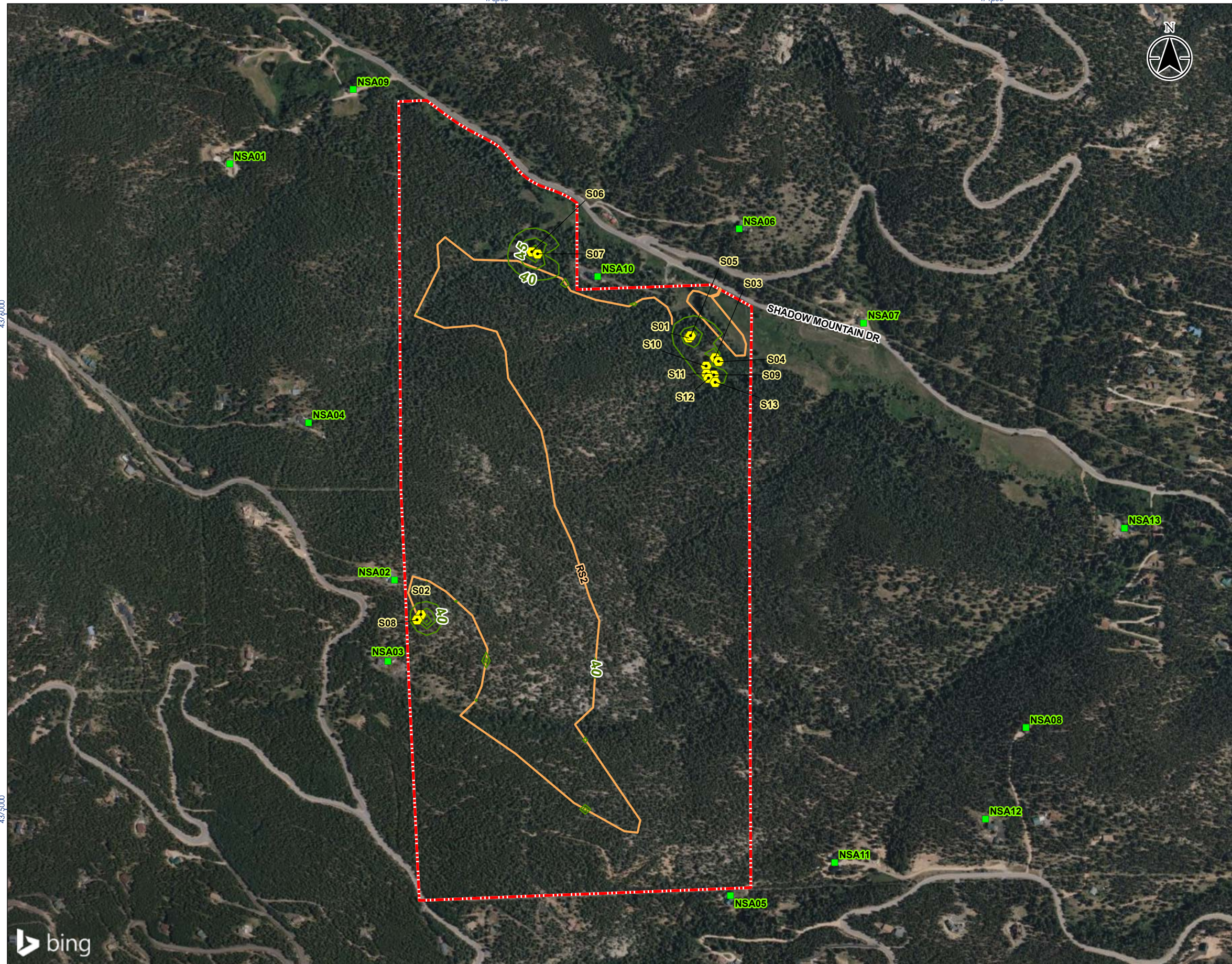
4375000

\\va004-prps05\work_group\01609\active_Other_POC_Active\009_GIS\181711248\03_data\gis_cad\gis\mxd\noise\report_figures\noise_181711248_noise_181711248_nighttime

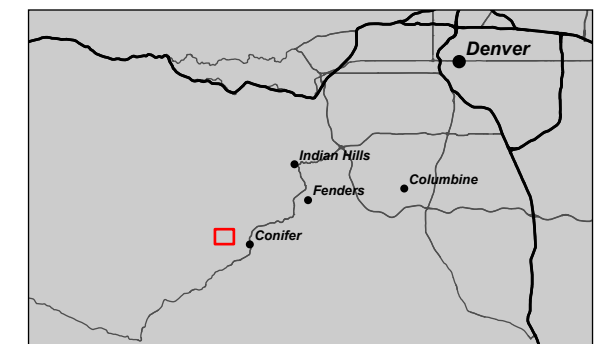
4375000

4375000

4375000



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



Project Location: Jefferson County, CO
 Prepared by MDA on 2024-03-19
 Technical Review by BCC on 2023-11-30

Client/Project: SE Group
 Shadow Mountain Sensory Impact Study - Noise

Figure No.: **A.5**
 Title: **Nighttime Stationary Noise Contour LA₂₅ 4.5m (15 ft. AG)**



470000






471000

470000

471000



Legend

-  Site Limit
-  Noise Receptor
-  Point Source
-  Line Source
-  Daytime Noise Contour 4.5m (15ft.) AG

4375000

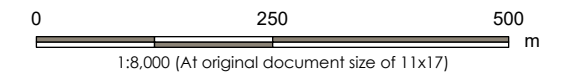
18171248_009_GIS\18171248_03_data\gis_cad\gis_md\noise\report_figures\noise_18171248_noise_18171248_fig06_Daytime

Revised: 2024-03-20 By: malcazaren

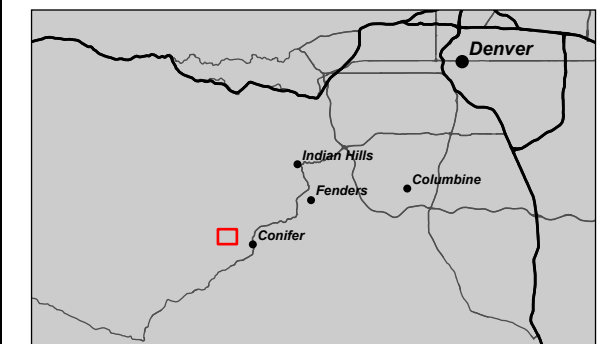
4375000

4376000

4375000



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



Project Location: Jefferson County, CO
 Prepared by MDA on 2024-03-20
 Technical Review by BCC on 2023-11-30

Client/Project: SE Group
 Shadow Mountain Sensory Impact Study - Noise

Figure No.: **A.6**
 Title: **Daytime Stationary Noise Contour LA₀ 4.5m (15 ft. AG)**



470000






471000

470000

471000

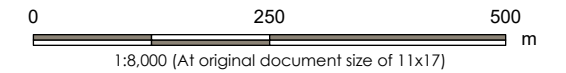
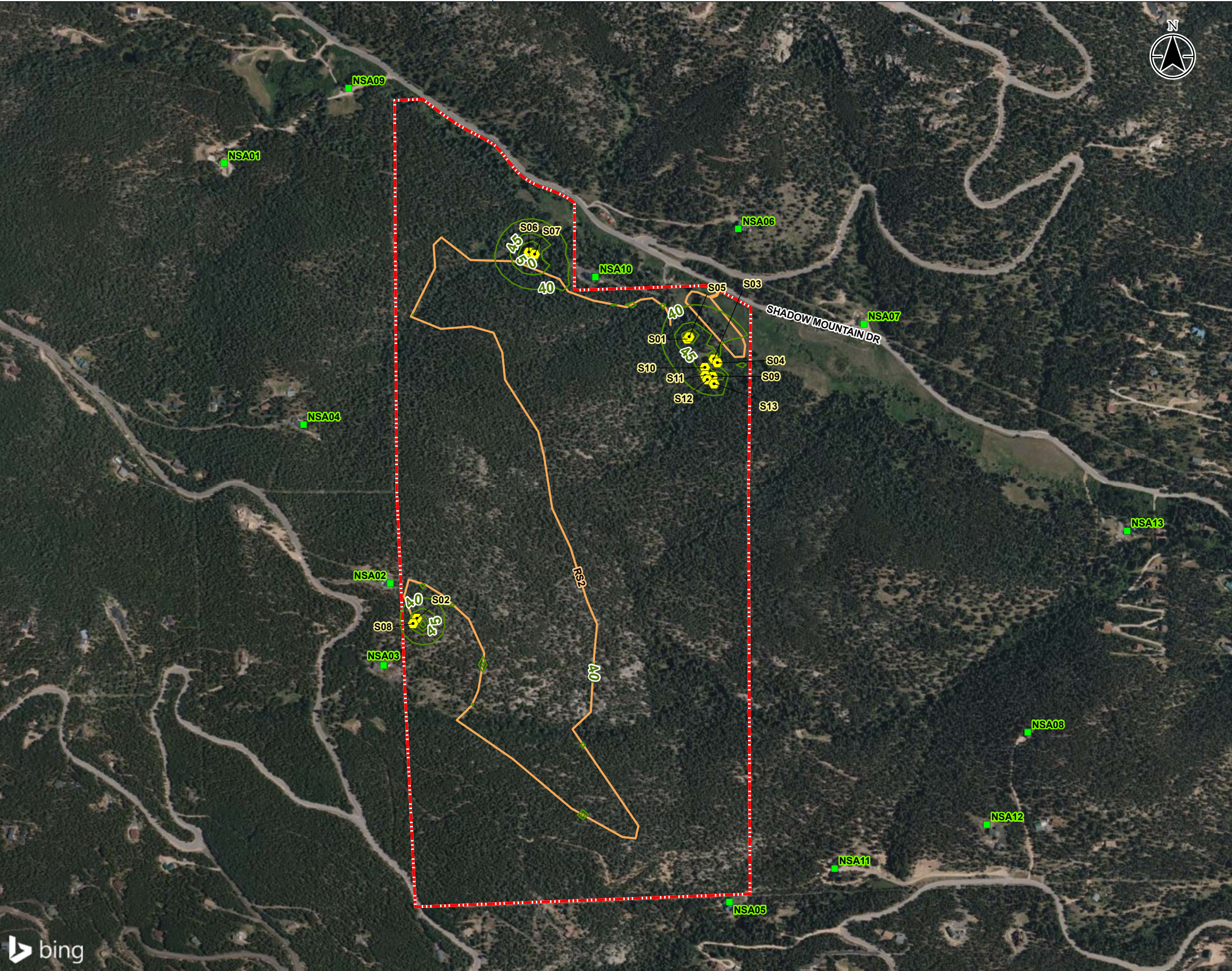


Legend

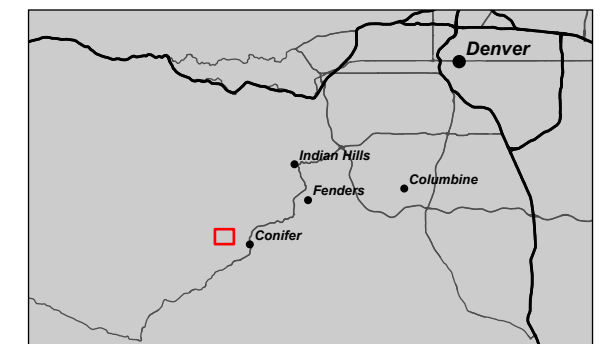
-  Site Limit
-  Noise Receptor
-  Point Source
-  Nighttime Noise Contour 4.5m (15 ft.) AG
-  Line Source

470000

471000



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



Project Location: Jefferson County, CO
 Prepared by MDA on 2024-03-19
 Technical Review by BCC on 2023-11-30

Client/Project:
 SE Group
 Shadow Mountain Sensory Impact Study - Noise

Figure No.: **A.7**
 Title: **Nighttime Stationary Noise Contour LA₀ 4.5m (15 ft. AG)**



V:\0004-ppes\04work_group\01609\active_Other_POs_Active\009_GIS\181711248\03_data\figs\noise\report_figures\noise_181711248_noise_is_spr\181711248_fig07_nightime
 Revised: 2024-03-20 By: malcazaren
 4375000
 4375000






Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

470000

471000



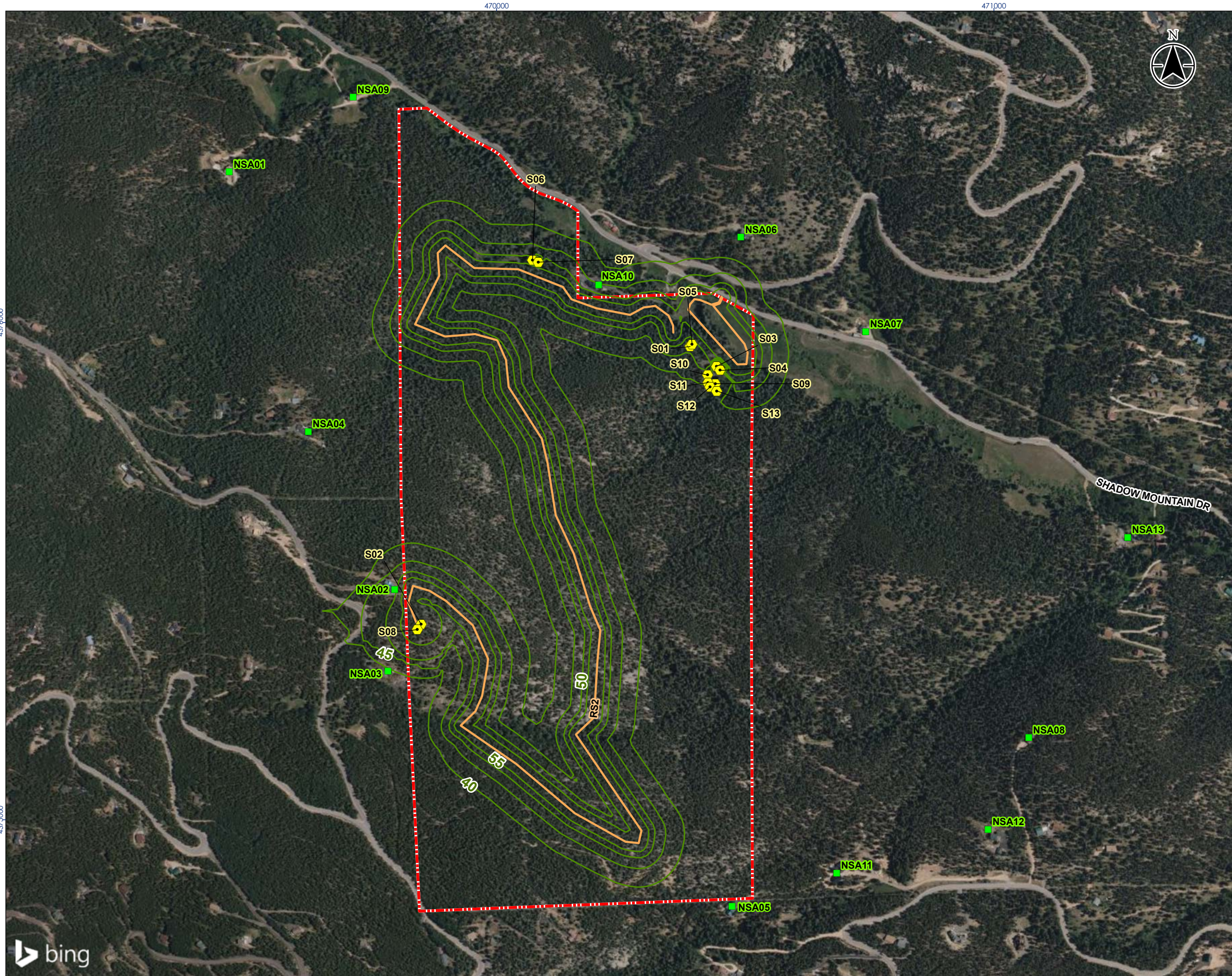
Legend

-  Site Limit
-  Noise Receptor
-  Point Source
-  Line Source
-  Daytime Noise Contour Lmax (dBA)

4375000

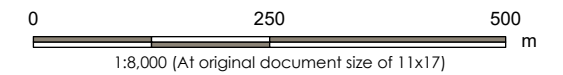
4375000

4375000

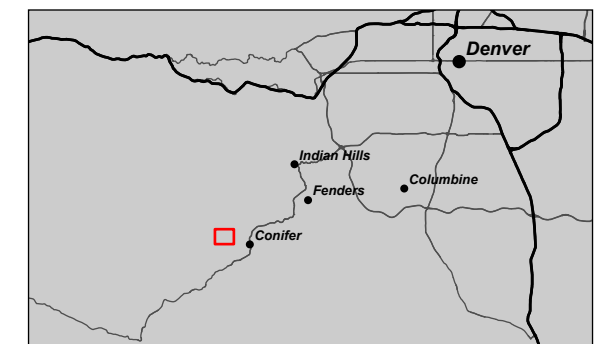


4375000

4375000



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 13N
 2. Base features produced under creative commons license with the Colorado Department of Transportation © 2022.
 3. Orthoimagery © 2024 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS



Project Location: 181711248 REVA
 Jefferson County, CO Prepared by MDA on 2024-03-19
 Technical Review by BCC on 2023-11-30

Client/Project:
 SE Group
 Shadow Mountain Sensory Impact Study - Noise

Figure No.
A.8
 Title
Daytime Mobile Noise Contour LA₀ 4.5 AG (15 ft. AG)

470000

471000



April 17, 2023

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Application for Special Use - 23-102980 RZ, Additional Water Supply Information

Dear Mr. Monke:

We are in receipt of the Second Referral Response Letter from the Jefferson County Engineering Geologist seeking additional information in regard to the Water Supply Information Summary, included as part of the Applicant's Special Use Application, Case No. 23-102980 RZ (the "**Application**"). This letter has been prepared to fulfill the Water Supply Information Summary requirement of our application and includes an updated well water permit application and engineer's report. The proposed bike park (the "**Project**") will require water use for daily operations, specifically in the proposed Day Lodge and in the Maintenance Building.

The following documents are provided in response to the comments received and are attached to this letter:

- Updated GW-45 General Purpose Water Well Permit Application, included as Attachment A, with updated legal description and withdrawal amount
- Updated Engineering Study for Water System Improvements, included as Attachment B, which incorporates and addresses the comments listed below.

Additionally, the following comments were received. Our responses to comments are included below. Additionally,

Comment 1. The site is not within a zoned or unzoned geologic hazard area and reports are not required with the rezoning process.

Response: Comment noted.

Comment 2. The property is located within the Mountain Ground Water Overlay District. Based the uses (bike park, lodge, maintenance building) on 306 acres, it appears the water requirement will not exceed the 0.28 acre feet per acre per year threshold as described in Section 21 of the LDR. If the water requirement exceeds 0.28 acre feet per acre per year, an Aquifer Test in accordance with Section 21 of the LDR is required with the rezoning application. If the water requirement exceeds 0.10 acre feet per acre per year, an Aquifer Test in accordance with Section 21 of the LDR is required with the SDP application.

Response: Comment noted. The Project is anticipated to remain well below the 0.28 acre feet per acre per year threshold. From initial calculations in the WAA spreadsheet provided

by the County, it is estimated that the Project would remain below 0.05 acre feet per acre per year (refer to Appendix C of Attachment B).

Comment 3. The applicant had previously submitted a plan that describes the process to obtain legal rights to the water supply, however, the number of guests has been updated (1200 max) and the plan should be updated with the revised values. Adequate legal water rights will be required with the SDP process.

Response: We have updated both engineer reports for the Water Supply Information Summary and the Onsite Wastewater Treatment System items based on this maximum guest use and the sources provided below. These are both included in this second referral resubmittal package and the water report is attached to this letter.

Comment 4. The Water Availability Analysis (WAA) has been completed based on water demand requirements listed in the Jefferson County OWTS regulations. The use is unique and a bike park is not listed, therefore, County staff referenced a “camps, day, no meals served” value in the WAA. The value utilized is 15 gallons per day (gpd) per guest (1200 guests based on revised ODP). The value utilized in Stantec’s October 23, 2023 Engineering Study was 4 gpd, however, no source data was provided. I discussed this with the applicant’s representative. Based on the values and ODP, the estimated consumptive use is ~2.6 af/yr.

Response: We followed up with Patrick O’Connell on this comment and had several conversations surrounding water uses, the Water Availability Analysis, and data sources. We have reached out to other similar facilities and have two data sources that support approximately 4 gallons per day (gpd) per guest. The first source is Staunton State Park; they provided visitation and water use data for their 2021 through 2023 winter and summer seasons for their visitor center, which has four toilets, four sinks, one drinking fountain, and no restaurant use. They have this one facility at their one entry portal and offer recreation opportunities such as hiking, mountain biking, and picnicking, all of which resemble what is proposed at SMBP. In the data shared by Staunton State Park, water use per guest ranged from 1.0 – 4.4 gpd in this time period; however, this was at the same time that the park had a leak in their water pipe as well. After the leak was fixed, visitation and water use data indicated an average use per guest of 0.3 gpd. Because 4.4 gpd is the maximum in this dataset, even with the leak, we believe this fully supports a guest use of 4 gpd as a high estimate for a similar use in a nearby area.

Additionally, Mr. O’Connell obtained a week’s data of water use and visitation at the Valley restaurant at Loveland Ski Area in Colorado. This ski area is a similar distance from a metropolitan area (approx. one hour from Denver) and offers a developed recreation opportunity for this population. Additionally, the Valley facility offers guest services such as restrooms and a ski school children’s center as well as a bar, restaurant, and cafeteria (for a total of two kitchens in the facility). Water use from this data was estimated at 7-8 gpd per guest including restaurant use. The EPA estimates that approximately 31-45% of water use in restaurants, office buildings, and educational facilities is attributed to domestic/restrooms (which is the only use for SMBP guests), which supports the estimate of about 4 gpd per guest for SMBP’s type of use.

With these data sources, we feel confident in our estimate of approximately 4 gallons per day per guest and have provided an updated WAA to Mr. O'Connell with this estimate. Our estimate assumes guest use of 275 days per year (given the seasonal closure described in our Special Use Plan) and employee use of 365 days per year. Consumptive use would be approximately 0.76 af/yr with these assumptions.

Comment 5. The Engineering Study should be updated with data/references for the 4 gpd value. The applicant should review the WAA (xls format) and provide data/references for alternative values as appropriate.

Response: See response above.

1. Grading within the Jefferson County Floodplain Overlay District (flood prone area) will require a separate Floodplain Development Permit.

Response: Comment noted.

In addition to the comments above, we have spoken with our case manager and Mr. O'Connell about our approach to obtaining water rights and have agreed to outline it here. We intend to construct a well for water use during normal operations. Normal operations include bike park operations in April through December outside of Special Events, as well as occasional employee use for maintenance from January through April. Well water will be used for toilets, sinks, and water fountains. We will pursue a nonexempt commercial well permit and water augmentation plan for normal operations and understands that this would need to be obtained prior to Site Development Plan approval. The water augmentation plan will supply the facility with approximately 4.72 acre-feet per year (afy) of water, as anticipated based on the assumptions described herein and as described in the attached engineer's report for water supply. We anticipate that pursuing a nonexempt well permit and water augmentation plan for up to 4.72 afy will be a long process and therefore plan to pursue an exempt commercial well permit, limited by a maximum annual withdrawal of 108,600 gallons per year (approximately 0.33 afy), for uses during construction and the start of operations. This would be a temporary use and water use would be highly monitored so as to not exceed the maximum annual withdrawal under the duration of this permit. This and other supplemental alternatives such as hauling water have also been discussed with the Colorado Division of Water Resources (DWR) and could contribute towards guest water use; as such, the DWR understands our intention for next steps.

We are committed to the assumptions included herein and understand the sensitivity around additional water use for this type of development. We also would like to reiterate that other uses, such as the recommended residential use for the Property, would allow water use of up to 298 gpd for one single family home according to the Conifer/285-Corridor Area Plan, and up to 25 homes on the Property. This would amount to approximately 7,500 gpd for the property (approx. 1 afy of consumptive use), as opposed to a maximum use of 5,400 gpd (approx. 0.75 afy of consumptive use) as estimated for this Project. That being said, we are also committed to limiting our water use where possible by installing water efficient toilets and sinks, monitoring visitation, and addressing leaks or other errors in the system as soon as they're discovered. We hope that this response will help your understanding of this project and address your concerns.

Sincerely,

A handwritten signature in black ink, appearing to read 'Phil Bouchard', written in a cursive style.

Phil Bouchard
Shadow Mountain Bike Park

A handwritten signature in black ink, appearing to read 'Jason Evans', written in a cursive style.

Jason Evans
Shadow Mountain Bike Park

Attachment A

GENERAL PURPOSE

Water Well Permit Application

Review instructions on reverse side prior to completing form.
 The form must be computer generated, typed or in black or blue ink.

1. Applicant Information

Name of applicant _____

Mailing address _____

City _____ State _____ Zip code _____

Telephone # (area code & number) _____ E-mail (online filing required) _____

2. Type Of Application (check applicable boxes)

Construct new well Use existing well

Replace existing well Change or increase use

Change source (aquifer) Reapplication (expired permit)

COGCC Well Other: _____

3. Refer To (if applicable)

Well permit # _____ Water Court case # _____

Designated Basin Determination # _____ Well name or # _____

4. Location Of Proposed Well

County _____

Section _____ Township _____ N or S Range _____ E or W Principal Meridian _____

Distance of well from section lines (section lines are typically not property lines)
 Ft. from N S Ft. from E W

For replacement wells only – distance and direction from old well to new well
 _____ feet _____ direction

Well location address (Include City, State, Zip) Check if well address is same as in Item 1.

Optional: GPS well location information in UTM format You must check GPS unit for required settings as follows:

Format must be UTM
 Zone 12 or Zone 13
 Units must be Meters
Datum must be NAD83
 Unit must be set to true north
 Was GPS unit checked for above? YES

Easting _____
 Northing _____

Remember to set Datum to NAD83

5. Parcel On Which Well Will Be Located (PLEASE ATTACH A CURRENT DEED FOR THE SUBJECT PARCEL)

A. Legal Description (may be provided as an attachment):

B. # of acres in parcel _____ C. Owner _____

D. Will this be the only well on this parcel? YES NO (if no list other wells)

E. State Parcel ID# (optional): _____

6. Use Of Well (check applicable boxes)

Attach a detailed description of uses applied for.

Industrial Dewatering System

Municipal Geothermal (production or reinjection)

Irrigation Other (describe): _____

Commercial

7. Well Data (proposed)

Maximum pumping rate _____ gpm Annual amount to be withdrawn _____ acre-feet

Total depth _____ feet Aquifer _____

8. Land On Which Ground Water Will Be Used

Legal Description of Land (may be provided as an attachment):

(If used for crop irrigation, attach a scaled map that shows irrigated area.)

A. # Acres _____ B. Owner _____

C. List any other wells or water rights used on this land:

9. Proposed Well Driller License #(optional):

10. Sign or Entered Name Of Applicant(s) Or Authorized Agent

The making of false statements herein constitutes perjury in the second degree, which is punishable as a class 1 misdemeanor pursuant to C.R.S. 24-4-104 (13)(a). I have read the statements herein, know the contents thereof and state that they are true to my knowledge.

Sign or enter name(s) of person(s) submitting application _____ Date (mm/dd/yyyy) _____

If signing print name and title _____

Office Use Only

USGS map name _____ DWR map no. _____ Surface elev. _____

Receipt area only

AQUAMAP
 WE
 WR
 CWCB
 TOPO
 MYLAR
 SB5

DIV _____ WD _____ BA _____ MD _____

GENERAL PURPOSE WELL PERMIT APPLICATION INSTRUCTIONS

Applications must be computer generated on-line, typewritten or printed in BLACK or BLUE INK. ALL ITEMS in the application must be completed. Incomplete applications may be returned to the applicant for more information. Applications are evaluated in chronological order. Please allow approximately six weeks for processing. This form may be reproduced by photocopying or computer generation. Reproductions must retain margins and print quality of the original form. If filing online see online filing instructions! You may also save, print, scan and email the completed form to: dwrpermitsonline@state.co.us For further information please visit dwr.colorado.gov

FEES: This application requires a nonrefundable \$100.00 filing fee. Please visit [DWR's Online Form Submittal](#) web page for acceptable payment information or contact DWR at (303) 866-3581.

USES: This form (GWS-45) is to be used to apply for commercial, industrial, municipal, irrigation, feed lot, geothermal (see Geothermal Rules for fee requirements), recovery wells, and other uses not otherwise noted in the following list:

RESIDENTIAL use wells – Use of form GWS-44 is required
LIVESTOCK watering on a farm, ranch, range or pasture (not feedlots) – Use form GWS-44
MONITORING/OBSERVATION wells – Use form GWS-46
GRAVEL PITS – Use form GWS-27
REGISTRATION of an existing well – Use form GWS-12 (must have been in use prior to May 8, 1972)
GEOEXCHANGE SYSTEM LOOP FIELDS – Use form GWS-72
REPLACEMENTS OF WELLS FOR THE ABOVE USES

ITEM INSTRUCTIONS: (numbers correspond with those on the front of this form)

1. The applicant is the entity for whom the permit is to be issued. Provide the applicant name and the mailing address where all correspondence will be sent.
2. Check all boxes that apply.
3. Complete all boxes that apply. If the permit is to be issued pursuant to a water court decree or a Designated Basin determination of water right, the case number or determination number must be indicated. If applying to replace or change the use of an existing well, the permit number of the existing well must be indicated.
4. The county, ¼ of the ¼ section designation, section #, township, range, principal meridian, and distances from section lines for the proposed well must be provided. (An option to providing distances from section lines and the ¼ of the ¼ section designation is to provide an accurate GPS location in UTM format. The required GPS unit settings must be as indicated on this form.) Colorado contains two (2) UTM zones. Zone 13 covers most of Colorado. The boundary between Zone 12 and Zone 13 is the 108th Meridian (longitude). West of the 108th Meridian is UTM Zone 12 and east of the 108th Meridian is UTM Zone 13. The 108th Meridian is approximately 57 miles east of the Colorado-Utah state line. On most GPS units, the UTM zone is given as part of the Easting measurement, e.g. 12T0123456. Check the appropriate box for the zone. Provide the property address of the well location if one exists. If it is the same as the mailing address, check the box next to the well location address.
5. **Please attach a current deed for the subject parcel.** Complete all boxes and provide a complete legal description of the parcel of land on which the well will be located. **If filing online please see online filing instructions for how to submit deed and or legal description attachments.**
6. Check all boxes that apply and attach a detailed description of the uses applied for.
7. Complete all boxes.
8. Complete all boxes and provide a legal description of the land areas on which ground water from the proposed well will be used. If agricultural irrigation is a proposed use, provide a map of the land area with proposed irrigated areas accurately drawn, including section numbers and section lines. A list of all other wells or water rights used on the described land must be provided.
9. The well must be constructed by a Colorado licensed well driller, an authorized individual in accordance with the Water Well Construction Rules, 2 CCR 402-2, or under the "private driller" provision as defined in CRS 37-91-102(12). A listing of licensed well drillers/pump installers is available [here](#).
10. The individual signing the application or entering their name and title must be the applicant or an officer of the corporation/company/agency identified as the applicant or their attorney. An authorized agent may also sign the application, if a letter signed by the applicant or their attorney is submitted with the application authorizing that agent to sign or enter their name on the applicant's behalf. If you filled the form out on-line you may save or print, sign, scan and email the form to the Division of Water Resources. Payment must be received via phone, fax or mail prior to processing the application.

IF YOU HAVE ANY QUESTIONS regarding any item on the application form, please call the Division of Water Resources Ground Water Information Desk (303-866-3587), or the nearest Division of Water Resources Field Office located in Greeley (970-352-8712), Pueblo (719-542-3368), Alamosa (719-589-6683), Montrose (970-249-6622), Glenwood Springs (970-945-5665), Steamboat Springs (970-879-0272), or Durango (970-247-1845), or refer to our web site at dwr.colorado.gov for general information, additional forms, and access to state rules or statutes.

Case No. 23-102980RZ

Legal Description

Street Location of Property Shadow Mountain Drive

Is there an existing structure at this address?

Yes _____ No X

Type the legal description and address below.

Parcel ID 61-163-00-001 is more particularly described by the metes and bounds of the said 306 acres, it is owned by the Colorado State Land Board. The corner quarter coordinates S 43° 07'29" E and N 00°19'28" W and is a locally preserved 70 acre quarter corner of the used 235 acre parcel #61-00-001. This 70 acre parcel corner sits S of Shadow Mtn Drive Road with road frontage facing the southeast quarter of Shadow Mountain Drive Road containing a R.O.W. of 60'. This quarter corner commences at the S2NW, SE and quarter corner of the NWNW said section 16, Township 6 South Range 71 West of 6th principal Meridian.

Section 16 Township 6 S. Range 71 W.

Calculated Acreage 235.316 Acres

Address Assigned (or verified) (Vacant Land) Shadow Mountain Drive

Attachment B

**ENGINEERING STUDY
for
SHADOW MOUNTAIN BIKE PARK
CONCEPT MASTER PLAN
WATER SYSTEM IMPROVEMENTS**

Prepared For:

**Colorado State Land Board
Shadow Mountain Bike Park
SE Group
Frisco, Colorado
PO Box 2729
323 West Main Street, Suite 202
Frisco, CO 80443-2729**

Prepared By:

Stantec

5725 Mark Dabling Blvd. Suite 190
Colorado Springs CO 80919

**November 2022
Revised October 2023
Revised April 2024
Project No. 181711248**

***** CONTENTS *****

Section 1	EXECUTIVE SUMMARY	1
Section 2	INTRODUCTION	2
2.1	Purpose	2
2.2	Scope	2
Section 3	EXISTING CONDITIONS	3
3.1	Description of Service Area	3
3.2	Land Use	3
3.3	Topography and Floodplains	3
3.4	Geology	3
3.5	Groundwater	3
3.6	Climate	6
3.7	Natural Hazards Analysis	6
3.8	Organizational Context	6
3.9	Water Facilities	6
3.10	Relationship to Neighboring Water and Wastewater Facility	7
3.11	Water Demand	7
Section 4	DEVELOPED CONDITIONS	9
4.1	Land Use	9
4.2	Population and Employment	10
4.3	Water Demand	10
4.4	Water Supply	12
4.5	Water Quality	12
4.6	Fire Flow Requirements	12
Section 5	WATER SYSTEM IMPROVEMENTS	13
5.1	General	13
5.2	Groundwater Wells	13
5.3	Treatment	13
5.4	Storage	13
5.5	Distribution	13
5.6	Estimated Costs	14
5.7	Rates and Charges	14

******* APPENDICES *******

Appendix A	100-Year Flood Plain Certification
Appendix B	Water System Improvement
Appendix C	Water Usage Data

******* LIST OF FIGURES *******

Figure 1	Vicinity Map
----------	--------------

Section 1 EXECUTIVE SUMMARY

This report presents the results of the engineering study for water system improvements serving Shadow Mountain Bike Park proposed on State Land Board Shadow Mountain parcels in Jefferson County, Colorado. Shadow Mountain Bike Park is proposed on undeveloped property with a designated address of 29611 Shadow Mountain Drive, Conifer, Colorado 80433.

The proposed parcel currently has no water facilities on site. Shadow Mountain Bike Park proposes construction of a minimum of one water well to provide potable water to the site facilities through a private water system.

Shadow Mountain Bike Park facilities will consist of a Base Lodge operating as a Class III Recreation facility to welcome guests and provide basic needs such as welcoming center including drinking water and restrooms as well as a maintenance facility for storage and employee use, including water and additional restroom.

The average annual water demand for Shadow Mountain Bike Park is estimated to be 4.72 acre-feet of water per year. Maximum day usage during operations between April 1st and December 31st is estimated to be approximately 5400 gpd or 3.75 gpm. This water will be provided by water wells as permitted by the Colorado State Engineers Office.

To meet Drinking Water Standards water will be filtered (if required) and disinfected prior to storage and will meet Colorado Department of Health and Environment Drinking Water Standards.

Fire Protection is provided by the Elk Creek Fire Protection District. Discussions with District Representatives indicate that they will require on-site fire protection that can provide 1500 gpm for 2 hours. To meet this requirement onsite Fire Storage will need to be 180,000 gallons exclusive of storage required for domestic use. This storage will be provided in a separate Fire Storage only ground storage tank; fire flow will be conveyed to the site through a fire flow distribution system to on-site fire hydrants.

Section 2 INTRODUCTION

2.1 Purpose

The purpose of this report is to present water system improvements recommended to serve Shadow Mountain Bike Park; a proposed recreational development project located in Jefferson County. It is also intended to serve as a guideline for the ensuing design of recommended improvements.

2.2 Scope

The scope of this report includes:

1. The definition of the service areas as well as identification of significant physical and environmental characteristics and constraints.
2. An analysis of available data to determine existing and to project future water supplies, demands and quality.
3. A description of legal, institutional and managerial arrangements that ensure adequate control of the proposed improvements; and,
4. A preliminary recommendation for a selected supply, treatment, pumping and transmission alternatives.

Section 3 EXISTING CONDITIONS

3.1 Description of the Service Area

Shadow Mountain Bike Park consists of approximately 235 acres of Base Lodge (10 acres +/-) and open space uses and is located northwest of Conifer, Colorado, within Township 6 South, Range 71 West, Section 16.

3.2 Land Use

Shadow Mountain Bike Park is in Jefferson County northwest of Conifer, Colorado and about 35 miles southwest of the Denver Metroplex. Surrounding areas are primarily large tract residential properties and large undeveloped tracts.

3.3 Topography and Floodplains

The topography of the service area is typical of a Colorado Front Range Mountain parcel with elevations ranging from 8400 ft. to 9250 ft. above sea level. Existing slopes range from 5% at base camp to 25% or greater in some areas. Vegetation is typical Colorado mountain woodlands with a mix of Ponderosa Pine, Spruce, Fir and ground cover plants and grasses. The area drains generally northeast to North Turkey Creek.

There is no Federal Emergency Management Agency (FEMA 08059CO365F) established floodplain within the boundaries of Shadow Mountain Bike Park. See Appendix A.

3.4 Geology

The site is comprised of several different soil types. From the NRCS Soil Survey of Jefferson County, the site falls into the following soil types:

1. "67" Kittredge-Earcree, 9 to 20 percent slopes; Type A Soil
2. "76" Legault-Hiwan stony loamy sands, 15 to 30 percent slopes; Type D Soil
3. "77" Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes; Type D Soil
4. "138" Rock outcrop, igneous and metamorphic; Type D Soil
5. "141" Rogert, very stony-Herbman-Rock outcrop complex, 30 to 70 percent slopes; Type D Soil

Note: "#" indicates Soil Conservation Survey soil classification number.

3.5 Groundwater

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. The applicant has been in discussion with the State Engineers Office concerning a well permit for the site including the type of permit and the uses permitted to ensure proper permitting. There are numerous wells in the area and discussions with the State indicate issuance of a permit could be made based on water rights associated with the property without injury to adjacent water rights.

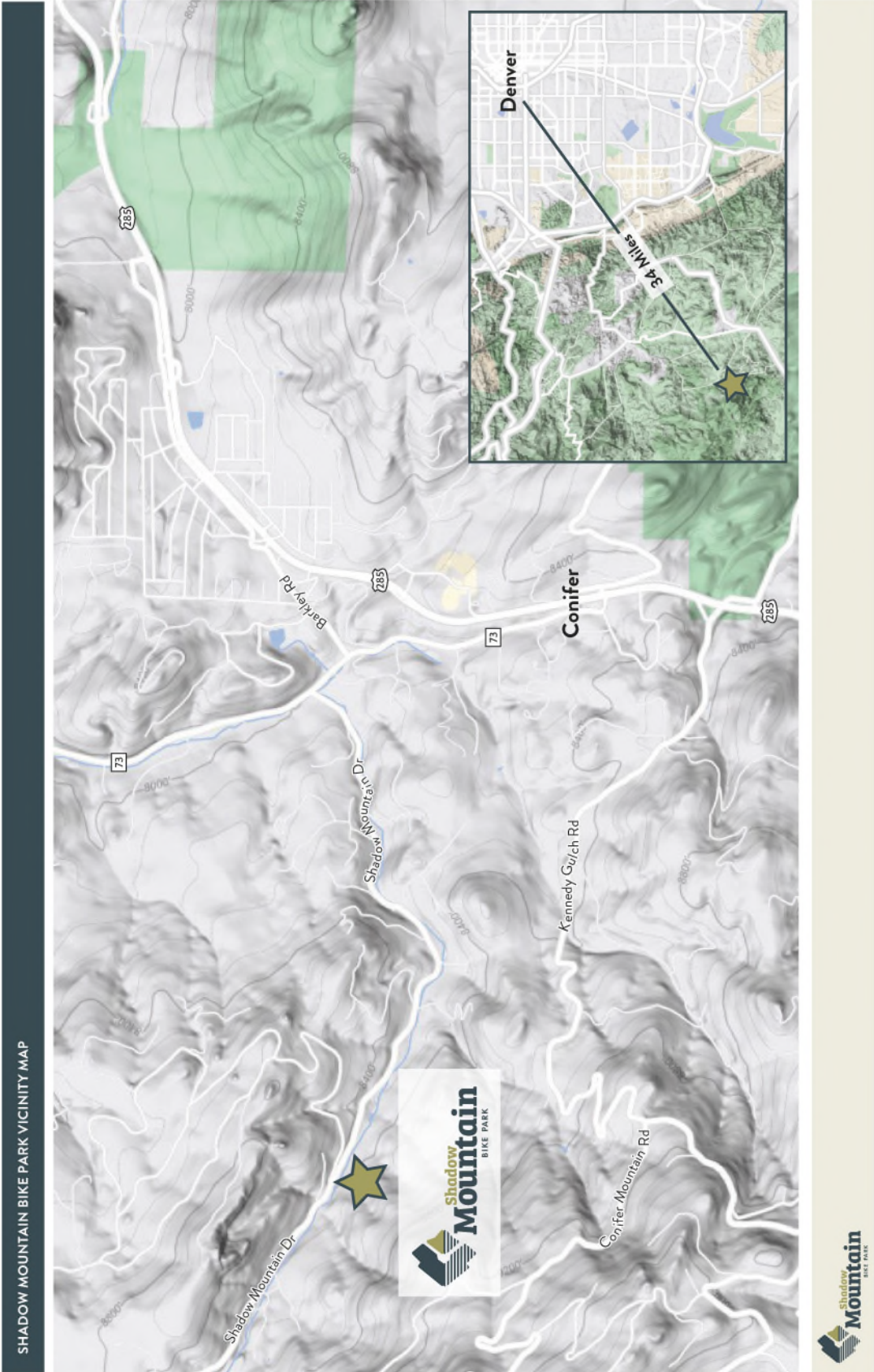


Figure 1: Vicinity Map

3.6 Climate

The climate of the study area is characterized by mild summers and moderately severe winters, moderate precipitation, high evaporation, and moderately high wind velocities.

The average annual monthly temperature is 43.5 F with an average monthly low of 10.3 F in the winter and an average monthly high of 76.1 F in the summer.

Precipitation averages 17.3 inches annually, with 50% of this falling as snow. August is the wettest month and January is the driest. The average annual Class A pan evaporation is 45 inches.

3.7 Natural Hazards Analysis

Natural hazards analysis indicates that no unusual surface or subsurface hazards are located in the service area. However, because the soils are cohesionless, sloughing of steep banks during drilling and/or excavation could occur. By siting improvements in a manner that provides an opportunity to lay the banks of excavations back at a 1:1 slope during construction, the problems associated with sloughing soils can be minimized.

3.8 Organizational Context

Shadow Mountain Bike Park is situated within the North Turkey Creek basin of Jefferson County. The closest public water supplier would be Mountain Water and Sanitation District in Conifer, Colorado. The distance and topography to Conifer in general is cost prohibitive in terms of a water supplier for the bike park.

The amount of water required for the facility and the distance to other providers makes an onsite private water system the best for meeting on-site demands. The Mountain Shadow Bike Park will be the entity responsible for financing, construct and ensure the continuing operation and maintenance of improvements.

3.9 Water Facilities

The proposed water system will consist of a minimum of one water well onsite and water treatment and disinfection based on source water conditions and Colorado Department of Health and Environment requirements. In addition, there will be a 6-inch water transmission line from the water well to the storage tank. Water will be stored to provide peak hour demand and fire sprinkler water for the onsite Base Lodge.

3.10 Relationship to Neighboring Water and Wastewater Facilities

Mountain Water and Sanitation District near Conifer, Colorado is the closest potential provider of water and wastewater facilities. The distance and topography between the site and the town make any connection cost prohibitive.

3.11 Water Demand

The Shadow Mountain Bike Park recreational development will be serviced by a private water system constructed by the developer of the bike park. The projected water demand for the facility is calculated in Section 4.3 Water Demand based on uses recorded at other Bike Park facilities.

Section 4
DEVELOPED CONDITIONS

4.1 Land Use

Mountain Shadow Bike Park consists of approximately 235 acres of State Land Board undeveloped property. Most of the site will be left undeveloped except for the addition of Bike Trails, a bike lift and development of approximately 10 acres for a base lodge including one building for welcoming, ticketing, water facilities and restrooms and one additional building for maintenance and employees with an additional restroom.

Assumptions: Employees water usage is estimated to be 20 gallons per day (gpd)
Guest Water Usage is estimated to be 4 gpd
Irrigation will be minimal or not required with xeriscape or extensions of the natural surroundings.

4.2 Population and Employment

The applicant estimates that there will be up to 30 onsite employees in a given day. The maximum day guest population is estimated to be 1200 as indicated in the applicant's special use plan. Guest and employee populations are estimated to be much lower on average; however, this report has been prepared to estimate maximum uses for water system design.

4.3 Water Demand

Water demand is estimated to be as follows:

Employees	30 x 20 gpd =	600 gpd
Guests	1200 x 4 gpd =	<u>4800 gpd</u>
	Total =	5400 gpd

These calculations indicate that during a maximum occupancy day the water system would need to be capable of delivering 5400 gpd. Yearly acre-feet requirements assume 275 operating days with guests and that the facility will be staffed year-round with employees. Estimated yearly acre-feet demand is as follows:

Employees	600 gpd x 365 days =	21,900 gallons = 0.67 ac-ft
Guests	4800 gpd x 275 days =	1,320,000 gallons = <u>4.05 ac-ft</u>

= 4.72 ac-ft yearly demand

Unit water demands for guests (4 gpd) are based on water usage data from Staunton State Park and Loveland Ski Area (See appendix C). Guest use is planned for 275 days between April and December, outside of the seasonal closure (January 1 through April 1) as defined in the applicant's special use permit. Unit water demands for employees are based on the EPA's Clean Water Toolkit for Sanitary Water Usage based on employees on site 365 days per year.

Water demand is calculated in acre-feet per year (AFY) to determine water supply needs. The maximum guest day is used to determine the average daily demand (ADD) in gallons per minute (gpm), which is used to project maximum day and peak hour demands. Maximum day demand (MDD) and peak hour demand (PHD) have been determined by applying accepted peaking factors of 2.5 and 4.0 to the ADD, respectively. The MDD is used to determine storage needs and the PHD is used for modeling system delivery pressures and to size distribution piping.

Demand

Gallons/day=	5400
ADD gpm=	3.75
MDD gpm=	7.5
PHD gpm=	15.0

Estimated Building Sprinkler demand is 20 gpm for 2 hours or 2400 gallons.

4.4 Water Supply

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. The applicant has been in discussion with the State Engineers Office concerning a well permit for the site including the type of permit and the uses permitted to ensure proper permitting. There are numerous wells in the area and discussions with the State indicate issuance of a permit could be made based on water rights associated with the property without injury to adjacent water rights. Most of the wells in the area range between 350 ft to over 600 ft. in depth. The nearby wells all indicate access to an “unnamed” aquifer and are all located in a “non-designated” basin.

Based on information from adjacent properties we would anticipate construction and completion of a water well between 500 and 600 ft. in depth in an unnamed aquifer.

The water well permit should be for a well capable of producing at a minimum the anticipated Average Day Demand and overall, yearly withdraw limits should not exceed 4.72 ac-ft annually.

4.5 Water Quality

The water quality and any mitigation required will be determined after construction of the well based on the permit obtained from the State Engineers Office. Mitigation anticipated may include filtering and disinfection. Anticipated treatments expected would be easily obtained with standard readily available locally provided treatment and disinfection equipment.

4.5 Fire Flow

Fire Protection is provided by the Elk Creek Fire Protection District. Discussions with District Representatives indicate that they will require on-site fire protection that can provide 1500 gpm for 2 hours. To meet this requirement onsite Fire Storage will need to be 180,000 gallons exclusive of storage required for domestic use.

In most domestic water systems, the Fire Storage component is 20 to 30% of the overall storage requirement. In this case the Fire Storage component is 94%. Storing water for long periods of time can lead to water quality issues primarily related to taste. Because of this concern, the domestic storage and the fire storage will likely need to be separated.

Fire Storage can be addressed in one of two ways and evaluation of the best alternative will need to continue through the Design Phase to determine the most economical and efficient system.

Ground Storage or Cistern with a Fire Pump

This system would require a 180,000-gallon storage tank approximately 30 feet in diameter and approximately 30 feet tall. Or alternatively a below grade 180,000 gallon cistern approximately 50 feet x 50 feet x 10 feet deep. Along with the storage there would be a requirement to install a 1500 gpm fire pump to deliver water at 20 psi. This type of fire pump would require a 25 HP motor. Included with the design would be a backup generator and fuel storage to provide electricity to the pump if the power failed during a fire.

Ground storage/elevated Fire Storage.

This system would require a 180,000-gallon storage tank approximately 30 feet in diameter and 30 feet tall located at an elevation approximately 50 feet higher than the facility. No fire pump or backup generator would be required, but approximately 2100 feet of transmission pipe would be required to convey water from the site to the tank.

In both cases some pipe would need to be located around the site to distribute to fire hydrant locations (2 maximum).

It would take a 10 gpm well approximately 12.5 days to fill the fire storage tank.

Some type of disinfection and/or aeration may be required in either system to prevent growth of bacteria that could interfere with the distribution of fire flow.

Evaluation of the two potential fire storage options will continue with final design. However, in order to avoid the expense of a large fire pump and backup generator and to use the advantage of gravity flow this report will assume the use of the second option, a ground storage elevated tank.

Section 5 WATER SYSTEM IMPROVEMENTS

5.1 General

The water system would be operated by the Shadow Mountain Bike Park and would be classified as a private water system and would be operated to meet the applicable requirements of the Colorado Department of Public Health and Environment (CDPHE). The system may be operated by a third party contracted by Shadow Mountain Bike Park and licensed by the State of Colorado.

Filtration and disinfection facilities provide treatment of the raw water sources to ensure good water quality. In addition, storage facilities and distribution piping will be provided to ensure that residual pressure requirements are achieved both during peak hour demands and during maximum day demands. The system will also be designed to deliver the required fire sprinkler water to the onsite building.

5.2 Groundwater Wells

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. As mentioned previously, the applicant has been in contact with the State Engineers Office concerning the parameters of a permit.

The water well permit should be for a well capable of producing at a minimum the anticipated Peak Hour Demand and overall, yearly withdraw limit should exceed 2 ac-ft annually.

The well will be equipped with a submersible well pump capable of delivering in excess of the Average Day Demand of 7.5 gpm. The well pump would be designed to deliver water to the domestic storage tank and fire tank. Final design characteristics will be based on the hydraulic characteristics of the well and the final configuration of the domestic and fire distribution systems.

5.3 Water Treatment

Treating and filtering of the water sources will meet CDPHE Drinking Water Standards.

In addition, CDPHE standards require that the water supply be disinfected and that the supply receives minimum chlorine contact time of 30 minutes before first use.

5.4 Storage

Storage reservoirs will be ground mounted and elevated steel tanks designed in accordance with CDPHE and AWWA Standards.

Potable Water Storage is sized to provide a minimum of 30% of maximum day demand. Required storage is calculated as follows:

Maximum Day Demand is 7.5 gpm. $7.5 \times 60 \times 24 = 10,800$ gallons

Estimated Storage Requirement = 10,800 gallons say 11,000 gallons

Tank size could be doubled to allow for special events (22,000 gallons). Normal operation would be between 8,000 and 12,000 gallons. Actual storage requirements and operational characteristics will be

addressed as final design proceeds.

Fire Demand Storage will be 180,000 gallons as stated in section **4.5 Fire Flow**. Water stored for fire flow will not be considered potable due to disinfection required to maintain functional fire flow storage for long periods of time without use.

5.5 Distribution

The water distribution system provides water at a maximum static pressure of 45 psi during periods of low use and at a minimum residual pressure of 40 psi during peak hour demand. The storage tank will be located at an elevation sufficient to meet these pressure requirements along with associated distribution and conveyance piping. Anticipated transmission and distribution piping is 6-inch.

Fire flow will be conveyed in its own distribution system to 2 fire hydrants located with the fire district input around the site near the building during final design. Each fire hydrant will be capable of conveying 1500 gpm at a minimum pressure of 20 psi. The anticipated fire system piping will be 6-inch minimum diameter.

5.6 Estimated Costs

Estimated Costs

Item	Units	Quantity	Unit Price	Extension
Shadow Mountain Bike Park				
Water Well	LS	1	\$50,000	\$50,000
Well Pump and Controls	LS	1	\$15,000	\$15,000
Potable Water Transmission	LF	5,800	\$35	\$203,000
Potable Storage	Gallons	22,000	\$3	\$66,000
Fire Storage Transmission	LF	2,500	\$35	\$87,500
Fire Storage	Gallons	180,000	\$2	\$360,000
Treatment	LS	1	\$40,000	\$40,000
Total Estimated Cost				<i>\$821,500</i>

The above system improvements are all constructed as part of Shadow Mountain Bike Park. These costs do not include other costs or gains that may be incurred in the acquisition of land, financing, investment, local distribution, the salvage value of equipment or other necessary infrastructure, among others, unless specifically noted. The above costs are estimated, actual costs may differ depending upon numerous factors including supply chain and cost increases at time of bidding.

5.7 Rates and Charges

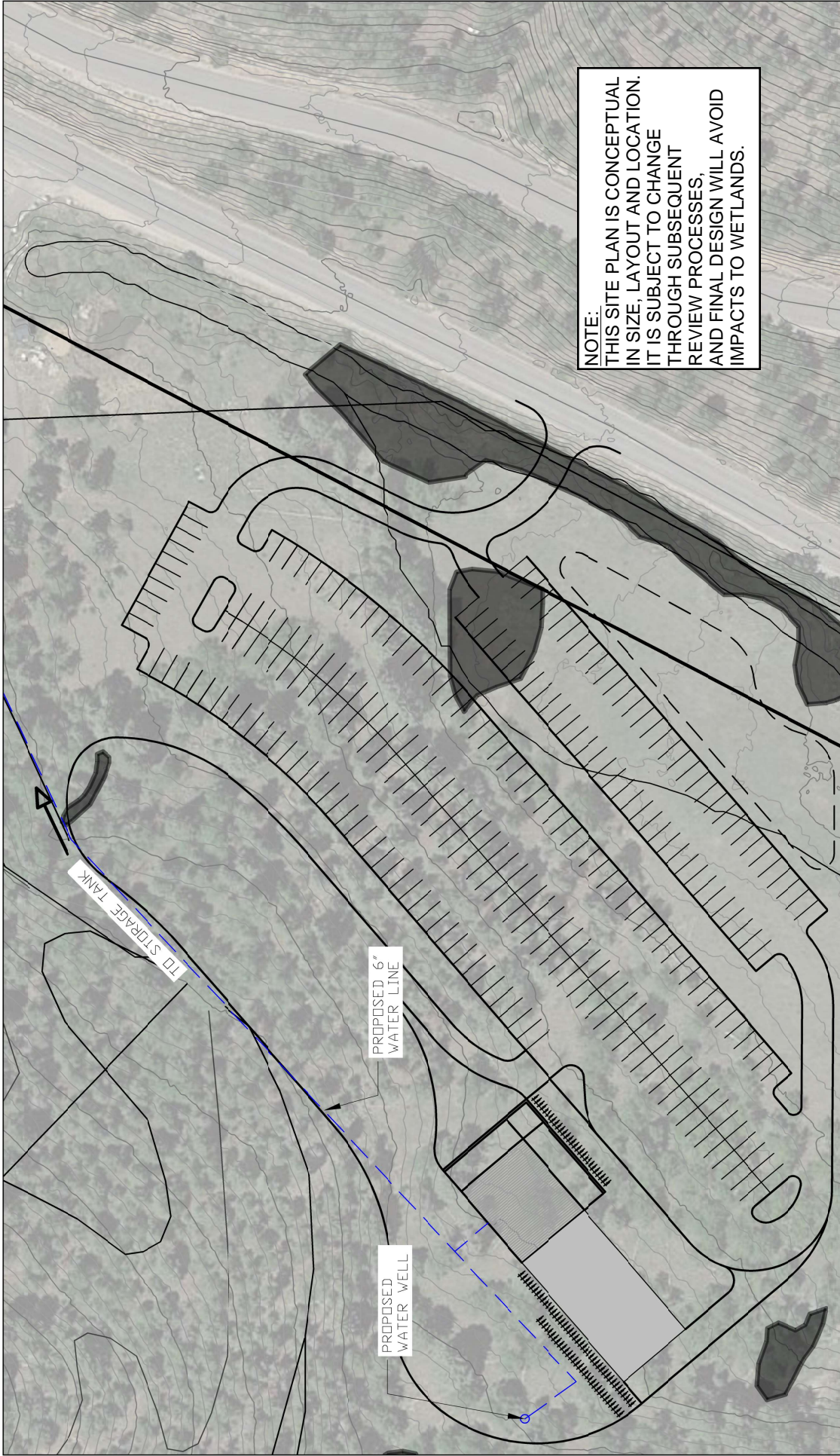
The waters system will be operated within the overall operation of the Shadow Mountain Bike Park through user fees charged to guests for the recreational facility.

Appendix A

100 Year Flood Plain Certification

Appendix B

Water System Improvements



WATER SYSTEM SITE DRAWING (A)
 SHADOW MOUNTAIN BIKE PARK

SCALE: 1"=60'

2000 S COLORADO BLVD
 SUITE 300
 DENVER, CO 80222





NOTE:
 THIS SITE PLAN IS
 CONCEPTUAL IN SIZE,
 LAYOUT AND LOCATION. IT
 IS SUBJECT TO CHANGE
 THROUGH SUBSEQUENT
 REVIEW PROCESSES,
 AND FINAL DESIGN WILL
 AVOID IMPACTS TO
 WETLANDS.

PROPOSED 22,000
 GALLON TANK

ACCESS ROAD

PROPOSED 6"
 WATER LINE

PROPOSED
 WATER WELL



WATER SYSTEM SITE DRAWING (B)

SHADOW MOUNTAIN BIKE PARK

SCALE: 1"=300'

2000 S COLORADO BLVD
 SUITE 300
 DENVER, CO 80222



Appendix C
Water Usage Data

**Jefferson County - Planning and Zoning Division
Water Requirement Report Worksheet**

Case Number	23-102980RZ
Property Address	-
ODP/Subdivision Name	Shadow Mountain Bike Park
Within MGWOD	Yes
Complies with MGWOD	

1) Calculate Water Withdrawal and Consumptive Water Use of Proposed Development

Type of Proposed Use	Description of Unit	FIXED FIELDS			INPUT	CALCULATED FIELDS			INPUT	Notes
		Annual Withdrawal per Unit (ac-ft per year)	Daily Withdrawal Per Unit (gpd)	Percent Consumptive Use	Number of Units	Total Annual Withdrawal (ac-ft per year)	Total Annual Consumptive Use of Water (ac-ft per year)	Average Water Withdrawal (gpd)	Occupancy Factor Per Year (days)	
Bike Park Guests (weekend)	People	0.00	4	16%	1200	4.05	0.65	4800	275	Seasonal closure Jan 1 to April 1
Bike Park Staff	People	0.02	20	16%	30	0.67	0.11	600	365	
Total						4.72	0.76	5400		

2) Calculate water requirement in terms of acre-feet per acre per year.

$$\frac{5400 \text{ gallons}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ year}} \times \frac{1 \text{ acre foot}}{325851 \text{ gallons}} \times \frac{1 \text{ project}}{306.0 \text{ acres}} = 0.02 \text{ acre-feet per acre per year}$$

3) Based on water requirements and Section 21 of the LDR, is an Aquifer Test required?

- Since the water requirement does not exceed 0.28 af/a/y, an Aquifer Test is not required with the rezoning application
- Since the water requirement is less than 0.10 af/a/y, an Aquifer Test is not required with the plat or SDP application

4) Aquifer Test Data

WELL DATA		AQUIFER TEST DATA				RECOVERY DATA			
Well Permit Number	Total Depth of Well (ft)	Static Water Level (ft)	Production Rate (gpm)	Extrapolated Production Rate (gpd)	Total Hours Pumped	Water Level When Pumping Stopped (ft)	Recovery-Hours After Pumping (hr)	Recovery-Water Level (ft)	Percent Recovered
Total									

5) Comments

- *Well Permit information not provided by applicant
- *1200 guests maximum based on revised ODP provided by applicant
- *80 bike park staff based on ratio in October 23, 2023 report (300 guest parking & 20 employee parking)
- *Daily guest withdrawal (4 gpd) based on 2021-2023 Staunton State Park water use data (applicant can provide data to County) and Loveland water use data (provided by County)
- *Daily employee withdrawal (20 gpd) based on EPA Lean Water Toolkit for commercial day use facilities without restaurant use (see References sheet)
- *Weekday/weekend visitation ratio from Bogus Basin bike park data for 2023 season (applicant can provide data to County)

Type of Proposed Use	Description of Unit	Annual Withdrawal per Unit (ac-ft per year)	Daily Withdrawal Per Unit (gpd)	Number of Units	Sources	Sq Feet	Description
Bike Park Guests	people		4		Staunton State Park Water Use and Visitation 2021-2023		Maximum use between 2021-2023 was up to 4.4 gallons per guest per day in November-December 2021; this was while Staunton State Park had a leak in their water line. Water use after the leak was fixed, water use was closer to 0.5 gallons per guest per day. Data is from Staunton's visitor center, which has 4 toilets, 4 sinks, and 1 drinking fountain. Thus, the Applicant references 4 gpd per guest as a conservative estimate of water use at a similar facility (parking lot and lodge), which would have a similar number of toilets and has a similar use (outdoor recreation).
Bike Park Employees	people		20		EPA Lean Water Toolkit		

https://dnrc.mt.gov/_docs/water/Water-Rights-Forms/615.pdf

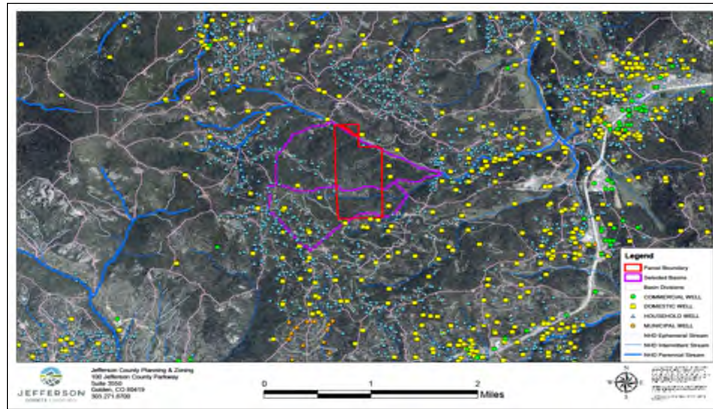
<https://www.jeffco.us/DocumentCenter/View/12324/Jefferson-County-Comprehensive-Master-Plan?bidId=>

<https://www.jeffco.us/DocumentCenter/View/1673/2018-Onsite-Wastewater-Treatment-System-Regulations-PDF?bidId=>

10–25 gallons per person per shift in industrial settings
The lower value is used where there are just toilets.
A higher value is used where there are toilets, showers, and full kitchen services (that is, food preparation and dish washing) **[the lower value is referenced here based on the proposed facility]**
20-35 gallons per employee per day for domestic demands (not including kitchens) in commercial/industrial settings
Savings of 25-35 percent in this domestic usage are readily achievable

[Lean & Water Toolkit: Appendix C | US EPA](#)

Water Availability Analysis of the Proposed Development on the Basin Groundwater Resources



Case Name: Shadow Mountain Bike Park
 Case Number: 23-102980RZ
 Date Prepared: 3.20.24

GIS Calculated
 Parameters
 Auto Calculated

Table 1: Estimate of Available Groundwater Resources in the Basin

Description	Variable or Equation	Value	Units
Basin area	A	753	acres
Average depth to groundwater in the basin (based on well permit data)	B	158	feet
Average depth of wells (based on well permit data)	C	371	feet
Saturated thickness of aquifer exposed to wells	D=C-B	213	feet
Estimated average porosity of aquifer	E	2.0%	
Basin Aquifer Group - alluvium		0%	% of basin
Basin Aquifer Group - highly fractured		1%	% of basin
Basin Aquifer Group - intrusive		63%	% of basin
Basin Aquifer Class - pikes peak		0%	% of basin
Basin Aquifer Group - metamorphic		36%	% of basin
Estimated amount of groundwater in storage	F=A*D*E	3211	acre feet
Effective yield of groundwater to wells	G	50%	
Estimate of groundwater in storage available to wells that are less or equal to the average depth	H=F*G	1605	acre feet
Estimate of groundwater stored in the basin aquifer per foot of saturated thickness	I=A*E*1-foot thick	15.06	acre feet per foot

Table 2: Analysis of Groundwater Withdrawal, Recharge, and Consumptive Use from Existing Wells in Basin

Equation or Variable	J	K	L=J*K	M	N=L*M	O _c =L-N
Type of Wells in Basin	Number of wells in Basin	Estimated amount of groundwater withdrawal in acre feet per year	Estimated amount of groundwater withdrawal in acre feet per year	Estimated percent returned to recharge groundwater	Estimated amount of groundwater recharge in acre feet per year	Estimated Consumptive Use of Water in acre feet per year
Domestic - household use portion	12	0.3	3.6	84%	3.0	0.6
Domestic - livestock watering (4 animals*10 gpd*365 days)		0.04	0.5	0%	0.0	0.5
Domestic - irrigation portion (1-acre*28 inches of water per year)		0.66	7.9	10%	0.8	7.1
Domestic (household use, irrigation, domestic livestock)	12	1	12.0	32%	3.8	8.2
Household Use	57	0.3	17.1	84%	14.4	2.7
Unaccounted HU wells based on existing structures (non vacant lots)	30	0.3	9.0	84%	7.6	1.4
Commercial	0	0.3	0.0	84%	0.0	0.0
Municipal (see comments for well at breakdown)	0	4.60	0.0	84%	0.0	0.0
Totals	99		38.1		25.7	12.4

*Wells may be associated with augmentation plan that allow for a lower withdrawal

Table 3: Estimate of Annual Groundwater Recharge to the Basin from Precipitation

Description	Variable or Equation	Value	Units
Basin area	A	753	acres
Mean annual precipitation based on NWS RFS data	P	19	inches
Average annual precipitation	Q=(P/12)*A	1209	acre feet
Estimated percent of annual precipitation that goes into groundwater recharge	R	3.5%	
Estimate of annual groundwater recharge to the basin from precipitation	S=Q*R	42.3	acre feet

Table 4: Ground Water Resource Impact of Proposed Development

Equation or Variable	J	K	L=J*K	M	N=L*M	O _p =L-N
Well Type Associated With Proposed Development	Number of Proposed Wells	Estimated amount of groundwater withdrawal in acre feet per year	Estimated amount of groundwater withdrawal in acre feet per year	Estimated percent returned to recharge groundwater	Estimated amount of groundwater recharge in acre feet per year	Estimated Consumptive Use of Water in acre feet per year
Domestic (household use, irrigation, domestic livestock)	0	1	0.0	32%	0.00	0.00
Household Use	0	0.30	0.0	84%	0.00	0.00
Commercial	1	4.72	4.7	84%	3.97	0.76
Municipal	0	0.00	0.0	84%	0.00	0.00
Totals	1		4.7		3.97	0.76

*Wells may be associated with augmentation plan that allow for a lower withdrawal than typical well type

Table 5a: Water Availability Analysis on the Basin Based on Existing and Proposed Development

Description	Variable or Equation	Value	Units
Consumptive use impact of existing development (e)	O _e	12.4	acre feet per year
Consumptive use impact of proposed development (p)	O _p	0.76	acre feet per year
Consumptive use impact of existing and proposed development (t)	O _t	13.1	acre feet per year
Estimate of groundwater recharge to the basin from precipitation	S	42.3	acre feet per year
Groundwater Budget=Groundwater Recharge-Total Consumptive Use	T=S-O _t	29.2	acre feet per year

*If groundwater budget value (T) is positive then the water supply appears to be adequate

*If groundwater budget value (T) is negative then the depth to water level will increase over time

Table 5b: Impact on the Basin Based on Existing and Proposed Development With 0 Recharge From Precipitation

Description	Variable or Equation	Value	Units
Estimated percent of aquifer depletion based on consumptive use of proposed development	U=O _p /H	0.05%	
Theoretical "annual average basin wide" drop in water level due to consumptive use of proposed development with 0 recharge from precipitation	V=O _p /I	0.05	feet
Theoretical time it would take to drain the saturated thickness of the basin by the consumptive use of the existing and proposed development with 0 recharge from precipitation	W=D/((O _t)/I)	245	years

Table 5c: Impact on the Basin Based on Existing and Proposed Development Including Estimated Recharge From Precipitation

Description	Variable or Equation	Value	Units
Theoretical time it would take to drain the saturated thickness of the basin by the consumptive use of the existing and proposed development with estimated precipitation recharge	X=D/((T)/I)	NA, since recharge exceeds consumptive use	years

Table 6a: Water Availability Analysis on the Basin Based Existing, on Build out of Platted Lots and Proposed Development

Description	Variable or Equation	Value	Units
Number of lots in basin	Y	116	lots
Number of vacant lots in basin	Z	17	lots
Number of wells associated with proposed development	J	1	wells
Consumptive use impact of build out of vacant lots	AA=Z*K(1-M)	0.82	acre feet per year

Table 6b: Impact on the Basin Based on Build out of Platted Lots and Proposed Development Including 0 Recharge From Precipitation

Description	Variable or Equation	Value	Units
Theoretical "annual average basin wide" drop in water level due to consumptive use at full build out based on platted lots and proposed development with 0 recharge from precipitation	AB=(O _t +AA)/I	0.9	feet
Theoretical time it would take to drain the saturated thickness of the basin by the consumptive use at full build out based on platted lots, existing, and proposed development with 0 recharge from precipitation	AC=D/((O _t +AA)/I)	230	years

Table 6c: Impact on the Basin Based on Build out of Platted Lots and Proposed Development Including Estimated Recharge From Precipitation

Description	Variable or Equation	Value	Units
Theoretical time it would take to drain the saturated thickness of the basin by the consumptive use at full build out based on platted lots, existing, and proposed development with estimated precipitation recharge	AD=D/(((T)+AA)/I)	NA, since recharge exceeds consumptive use	years

Table 7a: Water Availability Analysis on the Basin Based on Build out of Platted Lots, Additional Lots Allowed by Zoning and Proposed Development

Description	Variable or Equation	Value	Units
Number of lots in basin	Y	116	lots
Number of vacant lots in basin	Z	17	lots
Number of wells associated with proposed development	J	1	wells
Estimated number of additional lots allowed based on zoning	AE	53	lots
Consumptive use impact of existing development	O _e	12.4	acre feet per year
Consumptive use impact of build out of vacant lots	AA	0.82	acre feet per year
Consumptive use impact of build out of lots allowed by zoning	AF=AE*K(1-M)	2.54	acre feet per year
Consumptive use impact of proposed development	O _p	0.76	acre feet per year

Table 7b: Impact on the Basin Based on Build out of Platted Lots, Additional Lots Allowed by Zoning and Proposed Development With 0 Recharge From Precipitation

Description	Variable or Equation	Value	Units
-------------	----------------------	-------	-------

Theoretical "annual average basin wide" drop in water level due to consumptive use at full build out based on platted lots, allowed by zoning, and proposed development	$AG=(O_i+AA+AF)/I$	1.1	feet
Theoretical time it would take to drain the saturated thickness of the basin by the consumptive use at full build out based on platted lots, allowed by zoning, existing, and proposed development with 0 precipitation recharge	$AH=D/((O_i+AA+AF)/I)$	195	years

Table 7c: Impact on the Basin Based on Build out of Platted Lots, Additional Lots Allowed by Zoning and Proposed Development With Estimated Recharge From Precipitation

Description	Variable or Equation	Value	Units
Theoretical time it would take to drain the saturated thickness of the basin by the consumptive use at full build out based platted lots, allowed by zoning, existing, and proposed development with estimated precipitation recharge	$AI=D/((IT+AA+AG)/I)$	NA, since recharge exceeds consumptive use	years

Comments:
 *Inserted Row 50 to account for HU wells for existing structures (99)
 *water budget is positive which indicates an adequate water supply

Misc:

- Standard values to use for the WAA were based on data from the [USGS's 2003 Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed](#) and [CDM's 2011 Upper Mountain Counties Aquifer Sustainability Project Report](#)
[Link to 2003 USGS Report](#)
[Link to 2011 CDM Report](#)

Data Value Sources & References for the Water Availability Analysis (WAA):

- Basin Area – Defined basins are generated from ArcGIS based on USGS 10 Meter Digital Elevation Model (DEM) with each basin having a minimum area of 5 acres.
- Annual Precipitation – Based on the mean data (2005-2013) from the National Weather Service precipitation estimates from their River Forecast Centers (RFCs) which are on 4 by 4 kilometer grid system. The RFCs information is based on both radar and rain gauge data. The annual observed precipitation data from the closest RFC to the development project will be utilized in the WAA.
<http://water.weather.gov/precip/about.php>
- Estimated Recharge from Precipitation – Based on USGS's 2003 Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed (2%) and the CDM 2011 Upper Mountain Counties Aquifer Sustainability Project (references USGS study), the estimated recharge from precipitation is 2.0%.
- Estimated Recharge from Wastewater Returns – Based on several sources including the DNRs 1974 Consumptive Use of Water by Homes Utilizing Leach Fields for Sewage Disposal (88%), the Water Center of CSU 2007 Consumptive Loss from an ISDS in a Semi-Arid Mountain Environment (84%), the Journal of Hydrology 2010 Consumptive Use and Resulting Leach-field Drainage from a Mountain Residence (80%), and the CDM 2011 Upper Mountain Counties Aquifer Sustainability Project (references each study) the estimated recharge from wastewater returns is 84%.
- Well Data – ArcGIS data is provided by the Colorado Division of Water Resources. The well data will include the number of wells in the basin and the Use (Household, Domestic, Commercial, etc) to determine the volume of water permitted to be removed from the basin. Mean depth of the well and depth to water in the basin will be calculated from the attribute data. Certain uses (Commercial, Municipal, other) will require staff to review the well permit to determine the permitted withdrawal.
- Aquifer Groups – The (Metamorphic, Intrusive, Pike's Peak, Highly Fractured, and Alluvial) may be used to allow for a range for the Estimated Recharge from Precipitation based on Aquifer Group. Aquifer Group data is based on the CDM 2011 Upper Mountain Counties Aquifer Sustainability Project.

Shadow Mountain Bike Park

Phase I Drainage Report



November 2022

Last Revised February 2024

Prepared For:



Prepared By:



PHASE I DRAINAGE REPORT

For

Shadow Mountain Bike Park

November 2022

Last Revised February 2024

Prepared For



Shadow Mountain Bike Park

Conifer, CO

Prepared By



SE Group

Table of Contents

I.	GENERAL LOCATION AND DESCRIPTION	1
A.	Location.....	1
B.	Description of Property.....	2
II.	DRAINAGE BASINS AND SUB-BASINS.....	4
A.	Major Basin Description	4
B.	Sub-Basin Description.....	5
III.	DRAINAGE FACILITY DESIGN.....	6
A.	General Concept	6
1.	<i>Hydrologic Criteria</i>	6
2.	<i>Hydraulic Criteria</i>	8
B.	Specific Details.....	8
1.	<i>Permanent Stormwater BMPs & Maintenance</i>	9
IV.	CONCLUSION	10
A.	Compliance with Standards	10
B.	Drainage Concept	10
V.	REFERENCES.....	11
	APPENDICES	12

I. General Location and Description

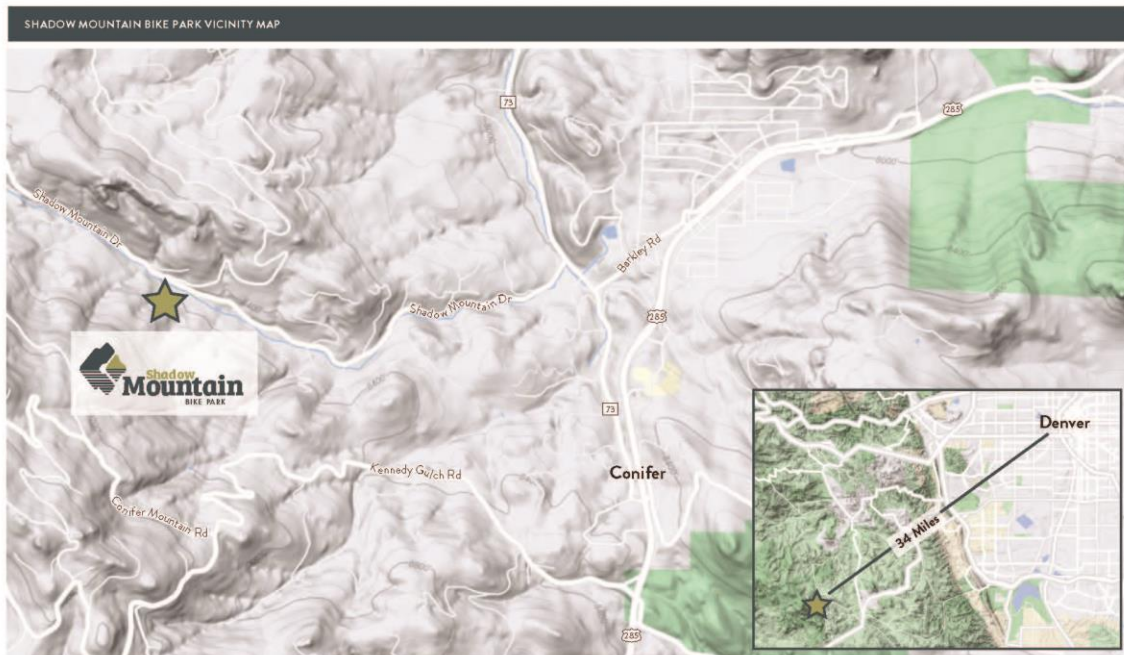
The Shadow Mountain Bike Park is to be designed in accordance with the Jefferson County Storm Drainage criteria. This report will review at a conceptual level the feasibility and design characteristics of the proposed development and is to accompany the project's Special Use Application materials. The Phase I Drainage Report is prepared in accordance with Jefferson County standards.

A. LOCATION

The Shadow Mountain Bike Park is proposed to be located at 29611 Shadow Mountain Drive in Conifer, CO. Conifer is an unincorporated community of Jefferson County, and the property is subject to the rules and regulations set by the County. The property is in Section 16, Township 6 South, Range 71 West of the 6th Principal Meridian, County of Jefferson, State of Colorado and is owned by the State Land Board. The property is comprised of approximately 306 acres of undeveloped land per County Assessor records, but the project is proposed only within the approximately 235-acre portion of the property south of Shadow Mountain Drive. It is proposed that the bike park would lease this southern portion of the property from the State Land Board and only develop and disturb a small fraction of the parcel.

The site is in a primarily rural, residential setting, bounded by residential neighborhoods along all property lines. The Conifer Senior High School and US Highway 285 are due east of the project. North Turkey Creek runs along the south side of Shadow Mountain Dr and bisects the front portion of the property; there are no existing drainage facilities. The project site is about four (4) miles from downtown Conifer and approximately 34 miles from Denver.

Figure 1. Vicinity Map



B. DESCRIPTION OF PROPERTY

The 235-ac portion of the property to be developed is located on an undeveloped hillside, sloping towards the North Turkey Creek and Shadow Mountain Dr. The northeastern portion of the site along Shadow Mountain Dr is relatively flat, from approximately 4% to 8%, as it extends from the roadway and then steepens up the mountain heading south-southwest, from 12% to 45%. The high point is in the southwestern most portion of the property at approximately 9250' and flows primarily due east-northeast into North Turkey Creek. The total vertical fall across the site is approximately 870 vertical feet. The flatter areas are predominantly meadows and grassy areas, and the hillside is primarily wooded. There are a series of low flow channels that bisect the property and flow into the North Turkey Creek. Throughout the site there are also wetlands on both the hillside and along the creek. The hillside is relatively consistent in grade with some knolls but no defined ridge. There are a series of small gullies formed by the low flow channels.

The property is in Zone X (unshaded) according to FIRM Map No 08059C0365F in Jefferson County, CO last revised February 5, 2014. Zone X (unshaded) is defined by FEMA as areas of minimal flood hazard, outside of the Special Flood Hazard Area (SFHA), and higher than the elevation of the 0.2-percent-annual-chance flood. A copy of the property FIRMette is included in Appendix A.

However, the Jefferson County floodplain include 100-year floodplains as identified by FEMA and flood prone areas as separately identified by the County. Per the County's public GIS Interactive Map (retrieved 2/21/23), a portion of the property is categorized as Jefferson County Flood Prone Areas. The floodplain layers in the Jefferson County Interactive Map include Jefferson County designated floodplains that have not been acknowledged by FEMA in addition to FEMA designated floodplains. The flood prone area is a buffer along the North Turkey Creek that bisects the site.

Per County requirement, floodplain development permits (FDP) will be required as part of the site development process and will be included in subsequent permitting processes.

Shadow Mountain Bike Park is a lift-served mountain bike park. The facility would include driveway access from Shadow Mountain Dr, onsite vehicular parking and guest drop-off, a base lodge with guest services (food & beverage, restrooms, seating, and bike/equipment rentals), and a mid-mountain maintenance building area. All access into the property would be via a two-lane (single in/single out) culvert crossing over North Turkey Creek. Water would be supplied by a water well and sewage would be handled by an onsite septic system.

The driveway access, internal drives & walkways, landscaping, and parking space design are to comply with the standards outlined by the Jefferson County Section 14 – Off-Street Parking and Loading. The parking and access would create impacts to waters of the U.S., including wetlands located in this area. Permitting would be required with the U.S. Army Corps of Engineers to comply with the Clean Water Act and County regulations. The culvert crossing of North Turkey Creek is to be sized according to the criteria set in Chapter 11.5 Culvert Sizing of the Jefferson County Storm Drainage Design & Technical Criteria. A Floodplain Development Permit will be required and approved prior to construction for all work within the County Flood Prone Areas.

It is anticipated that mountain access be provided via a four-passenger chairlift to be constructed to transport guests and bikes to the top of the property for gravity flow and downhill trails. The proposed lift would include a bottom and top terminal building with an accessory lift attendant building; all lift infrastructure (terminals and towers) would comply with the height limit of 35-feet. The facility may provide, but would not be limited to, approximately 20 miles of trails. These trails would be primarily constructed of earthen materials, and would include wooden, steel and other materials. Vegetation removal would be necessary for the construction of the chairlift and trails. Industry trail design practices would be utilized for construction and maintenance of trails and the lift corridor.

A work road would be constructed from the main base area to the north to the location of a maintenance shop. The work road would also be constructed to the chairlift top terminal location providing construction and maintenance access, as well as emergency access through the bike park. The maintenance shop is likely to be located mid-mountain and constructed atop a hard, gravel surface. The approximate location is provided on the attached Drainage Map, but the final footprint and location is subject to change.

The maintenance access road and designated bike trails will likely cross the existing low flow channels within the site. Both the trails and road are to be routed and designed to minimize impacts to the channels and delineated wetland areas.

II. Drainage Basins and Sub-Basins

A. MAJOR BASIN DESCRIPTION

The proposed site is tributary to the North Turkey Creek and is part of the Turkey Creek Major Drainage Basin. The North Turkey Creek begins in the hillside above Shadow Mountain Dr, flows east-northeast alongside Rte. 285 and N. Turkey Creek Rd before its confluence with Turkey Creek. According to the Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed completed in 2001, the site is entirely within the North Turkey Creek sub-basin. This sub-basin is designated as Subbasin K. Applicable sections of the report are included in Appendix B.

Subbasin K is approximately 4,800 acres and is largely undeveloped with areas of residential and limited commercial development, and some roadways, both gravel and paved county roads. The basin encompasses much of the unincorporated community of Conifer, including the commercial district along Rte. 285 and the Conifer High School; the basin does not include the Aspen Park area. Historically, flows start from the ridgeline along the southwest edge of the Major Basin and sheet flows or enters small drainageways to the north/northeast into North Turkey Creek. The basin also includes minor flows from the north of the creek. North Turkey Creek flows to the east and the Major Basin delineation ends at Route 70. The creek continues to flow north before its confluence with Turkey Creek. Slopes vary throughout the Major Basin ranging from steep slopes at upwards of 40-45% to flat grassy areas from 2-5%.

There are no existing major drainage facilities within the Major Basin.

Added imperviousness for the developed site is assumed to be negligible within the Major Basin because full spectrum detention is to be provided onsite and attenuated to historic levels. Thus, no negative impacts are anticipated to the North Turkey Creek major drainageway basin because all increases in site imperviousness, although very small, are treated and detained onsite.

The Major Basin follows Jefferson County zoning and is a mix of Mountain Residential (MR) & Suburban Residential (SR), Planned Development (PD), Commercial (C), and Agricultural (A) Districts. The property is zoned for A-2 Agricultural Two District. The project's proposed development would be defined as a Class III Commercial Recreational Facility and is thus subject to a Special Use/Rezoning review process before proceeding with the Site Development Plan process. The project aligns with the goals of the Conifer-285 Corridor Area Plan by providing an active recreational area that maintains the mountain community character.

There are no known irrigation facilities such as ditches that will or would be influenced by the North Turkey Creek in the vicinity of the property.

B. SUB-BASIN DESCRIPTION

Historically, the property drains into the North Turkey Creek via sheet flow or channelized flow in a series of low flow channels bisecting the hillside. Runoff largely flows to the east-northeast into the abutting property before entering the creek. The site is undeveloped with majority of the surface area covered by wooded areas and meadows along Shadow Mountain Drive.

The USDA Soils Survey states that the site is largely Leguault-Hiwan stony loamy sands, 5 to 15 and 5 to 30 percent slopes, or rock outcrop complex 30 to 50 percent slopes on the hillside and then Kittredge-Earcree complex, 9 to 20 percent slopes, along the street frontage. The stony loamy sands and rock outcrop complex are Hydrologic Soil Group (HSG) D and the Kittredge-Earcree complex is HSG B. Soils with a B HSG rating are in the above average soils class for infiltration and D HSG rating is the lowest group and has the least amount of runoff infiltration. According to the USDA, 95% of the property has a HSG D soils rating. A copy of the Soils Survey is provided in Appendix C.

The property is split into distinct developed areas that impact the existing property: the new mountain bike trails, the lift and associated terminal and tower structures, the maintenance building and access road, and base services and parking area. It is proposed that the trails, lift areas, access road, and maintenance building use stormwater best management practices to mitigate impacts. Runoff generated by the new base lodge and parking area is to be redirected to an onsite detention facility to treat and detain access flows prior to being released into the North Turkey Creek. The detention facility is to be designed per Jefferson County and Mile High Flood District (MHFD) standards; preliminary calculations are provided in this report. The site improvements will not alter the existing minor and major drainage patterns of the property and all flows will continue to enter the creek.

The section of North Turkey Creek that crosses the property is to remain functional and stay adequately protected during construction to the greatest extent possible. The proposed driveway crossing over the creek is to be designed and constructed per county and MHFD standards and best practices. The functionality and capacity of the existing drainageway is to be restored to the historic conditions.

III. DRAINAGE FACILITY DESIGN

The preliminary drainage facility design has been prepared in accordance with Jefferson County Storm Drainage Design & Technical Criteria and the latest MHFD Urban Storm Drainage Criteria Manuals (USDCM), Vol. I revised August 2018, Vol. II revised September 2017, and Vol. III revised January 2021 and MHFD design tools for Detention Design, v4.06 revised July 2022 and Rational Method revised May 2017.

A. GENERAL CONCEPT

Historically the runoff from the site is un-detained and directly discharging to North Turkey Creek. The developed site will produce a higher runoff volume due to increased imperviousness from the base lodge and parking area, and this runoff is to be detained to or below existing runoff rates per MHFD standard through the addition of storm sewer and the on-site full spectrum detention pond. All new onsite drainage facilities are to be encumbered by drainage easements per County regulations. Easement delineation and language to be provided within final construction documents.

There are flows that enter the site from the abutting properties to the west. All offsite flows are to be redirected around the proposed developed areas to the creek and not collected by the new drainage facilities.

The added imperviousness from the mountain bike trails, lift terminals, access road, and maintenance area are to be mitigated using Low Impact Development (LID) best practices and selection and sizing of stormwater BMPs that improve runoff quality and minimize impacts to the existing surfaces.

Surface disturbance from construction activities to be mitigated and controlled by temporary erosion control measures and follow a Grading, Erosion and Sediment Control Plan. The plan is to be provided as part of the final construction documents and reviewed during the Site Development Plan process.

1. HYDROLOGIC CRITERIA

The Rational Method ($Q=CIA$) is used to determine runoff peak discharges for the historic and developed site basins at given design points. The composite runoff coefficients (C) are calculated using site imperviousness and hydrologic soil type (HSG B & C/D) to define an area-weighted coefficient per basin. The rainfall intensity (I) in inches per hour are defined using the time of concentration (t_c) and provided intensity-duration curve table provided within the County Storm Criteria Manual Chapter 5.4 for Jefferson County Rainfall Zone IIB. The Time-Intensity-Frequency curves for each zone were developed by distributing the one-hour point rainfall values using the factors obtained from the NOAA Atlas 14 for durations of less than one hour. The point rainfall values from Table 501 within the Criteria Manual are as follows:

Table 1: One-Hour Point Rainfall Values for Jefferson County Rainfall Zone IIB (in)

2-YR	5-YR	10-YR	50-YR	100-YR
0.85	1.19	1.39	1.93	2.20

Each basin was evaluated based on area (A) in acres. Final peak discharge (Q) is defined in cubic feet per second (cfs). Post-development time of concentration calculations for each subbasin, corresponding rainfall intensities, and composite runoff coefficients for each sub-basin as calculated using the MHFD UD-Rational Method spreadsheet are provided in Appendix D.

The proposed base lodge and parking facilities are to disturb approximately 6.75 acres of historically undeveloped area:

- **Basin H:** The historic basin, labelled as Basin H is split into two sub-basins H1 and H2 for the HSG D and HSG B soils respectively.
- **Basin D:** The developed basin, labelled as Basin D, is split into two sub-basins D1 and D2 for the HSG and HSG soils respectively as well. Basin D represents all disturbed areas that are tributary to the proposed detention basin.
- **Basin OS:** All flows that cannot be conveyed to the basin are analyzed within the OS (offsite) basin. All soils within the Basin OS are HSG B.

Per Chapter 6 of the MHFD Urban Storm Drainage Criteria Manual (USDCM) Vol. I, Table 6-3, packed gravel surfaces are 40%, drive and walks are 90%, and roofs are 90% impervious. The proposed plaza area around the building and bottom lift terminal is likely to be a hardpacked dirt surface and is assumed 25% imperviousness.

The calculated peak flows for the minor storm event (5-year) and the major storm event (100-year) for the base lodge and parking area are as follows:

Table 2: Runoff Summary Table

Basin	Total Area (ac)	HSG	Imperviousness (%)	Q5 (cfs)	Q100 (cfs)
H1	2.74	D	2	0.43	7.68
H2	4.01	B	2	0.10	6.89
D1	2.74	D	43	2.98	11.06
D2	3.61	B	31	3.04	10.93
OS	0.40	B	2	0.56	0.81

The calculated release rates through the Rationals Method to be used as reference only. The final detention basin design and required release rates to be determined using the MHFD standards outlined below.

The proposed detention basin is to be designed to MHFD standards for an Extended Detention Basin (EDB). An EDB is proposed for the site in lieu of other drainage options, such as bioretention, because there is at least 5 acres of tributary area to the basin. The EDB is to be sized to store the tributary water quality control volume (WQCV), excess urban runoff volume (EURV), and 100-year storm event using the latest MHFD Detention Basin Design Workbook.

Preliminary calculations for basin storage are provided in Appendix E.

2. HYDRAULIC CRITERIA

Site runoff is proposed to be conveyed via sheet flow into a series of storm inlets and storm sewers before outfalling into the EDB. All site drainage design within the parking facilities to comply with the standards set by the Jefferson County Zoning Resolution, Section 14 – Off-Street Parking and Loading. Per the manual, sheet flow shall not exceed 200 feet, parking areas wider than 42 feet shall control concentrated flow via swales and/or underdrains, and no drainage from areas other than parking shall be diverted to and cross parking areas.

Final hydraulic design to be provided during the Site Development Plan process as part of a Phase III Drainage Report. The final storm sewer system is to be designed in accordance with MHFD USDCM Volume I Chapter 7 and sized accordingly. The storm sewer network is to be analyzed for the 5-year and 100-year storm events and is to include capacity, minimum and maximum velocity, and HGL considerations; it is the intent for the final storm sewer design to be sized so that the 100-year HGL remains below the finished grade. The storm inlets are to also be analyzed for the minor and major storm event to ensure adequate capacity and bypass in accordance with Chapter 7 design criteria.

The driveway culvert crossing at North Turkey Creek is to be designed and constructed in accordance with the Criteria Manual Chapter 11, specifically complying with 11.5.1 Culverts within Drainageways; final calculations and details to be provided during the Site Development Plan process. The culvert is to be designed to the minimum design standard set by the Criteria because the crossing remains outside of the 100-year floodplain. If only a small increase in culvert size is required to prevent overtopping, then a larger culvert is to be proposed. Final culvert sizing is to require additional major basin flow analysis using the Colorado Urban Hydrograph Procedure (CUHP) to establish the 10-year and 100-year flows within the creek.

B. SPECIFIC DETAILS

The EDB is to be designed to MHFD standard and include forebays at entering storm sewer outfalls, trickle channels, outlet structure, and an emergency overflow embankment. Each structure within the basin is to be designed and sized with calculations, design considerations, and construction details provided in the construction documents. The basin is also to be designed to maintain vegetation and have max 3:1 to 4:1 side slopes planted with turf grass that allows for consistent coverage and a mowable surface. Detailed access is also to be provided into the basin which may include a stabilized path to the internal structures or a detailed maintenance plan for sediment removal within the outlet structure, micropool, forebays, etc. The final basin footprint is to be as naturally and aesthetically shaped as possible with the outlet structure remaining as hidden from the right of way as possible and not deter its functionality.

The preliminary volume calculations and water surface elevations are as follows:

Table 3: Preliminary Basin Summary

Drainage Area (ac)	Required WQCV (ac-ft)	Required 100- year Volume (ac-ft)	Required Total Basin Volume (ac-ft)	Volume Provided (ac-ft)	100-yr Release Rate (cfs)
6.35	0.095	0.184	0.440	0.578	7.9

PERMANENT STORMWATER BMPS & MAINTENANCE

EDBs have low to moderate maintenance requirements with potentially significant maintenance required every 15-25 years. The proposed site EDB is to be maintained routinely per MHFD Vol III recommendations. Routine maintenance includes debris and litter removal, mowing and plant care, sediment removal, and erosion and structural repairs. Native grass and other drought tolerant plantings may be proposed to maintain effective vegetation without requiring permanent irrigation facilities.

The mountain bike trails are to be routinely inspected and maintained to ensure functionality and limit erosion and sediment travel downstream. Temporary erosion control measures to be implemented during active construction may include sediment fencing or sediment control logs, sediment basins, temporary rock check dams, and stabilized construction entrances. Permanent structures may include bridge crossings or cross culverts at existing seasonal waterways, ditch turnouts or constructed filter berms, and drainage swales.

IV. CONCLUSION

The Shadow Mountain Bike Park is to comply with the design criteria set by Jefferson County. This Phase I Drainage Report reviews at a conceptual review the feasibility and design characteristics of the proposed bike park development.

A. COMPLIANCE WITH STANDARDS

The proposed drainage facilities for the development of Shadow Mountain Bike Park are to be designed in accordance with Jefferson County rules and regulations including the criteria set by the Storm Drainage Design & Technical Criteria and the Zoning Resolution. Per County recommendations, the facilities are to follow design criteria and recommendations set by the MHFD within the USDCM Criteria Manuals.

B. DRAINAGE CONCEPT

The proposed drainage facilities at the base area are to be designed for full spectrum detention and will thus not have a negative impact on downstream properties and the existing North Turkey Creek functionality. The project is to be subject to a sitewide Grading, Erosion and Sediment Control Plan that will dictate temporary construction stormwater BMPs and construction practices to protect the area during active earthwork and construction. The bike trails, lift areas, access road, and maintenance area are to be constructed with stormwater BMPs to provide permanent solutions erosion and sediment control. All proposed improvements are to be adequately maintained to ensure functionality.

V. REFERENCES

Storm Drainage Design & Technical Criteria, Jefferson County. Revised December 2019.

Zoning Resolution, Jefferson Country. Published June 2022.

Conifer/285 Corridor Area Community Plan, Jefferson County. September 2003.

Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed, Jefferson, Colorado, 1998 – 2001. US Geological Survey, Water-Resources Investigations Report 03-4034. Published 2003.

Urban Storm Drainage Criteria Manual, Vol. 1: Management, Hydrology and Hydraulics, Revised August 2018.

Urban Storm Drainage Criteria Manual, Vol. 2: Structures, Storage and Recreation. Revised September 2017.

Urban Storm Drainage Criteria Manual, Vol. 3: Stormwater Best Management Practices (BMPs). Revised January 2021.

FIRM Flood Insurance Rate Map, Map Number 08059C0365F, Jefferson County, Colorado. Federal Emergency Management Agency. Revised February 5, 2014.

United States Department of Agriculture, Natural Resources Conservation Service. Custom Soil Resource Report.

APPENDICES

APPENDIX A – FIRM MAP

APPENDIX B – REDACTED MAJOR DRAINAGEWAY PLAN

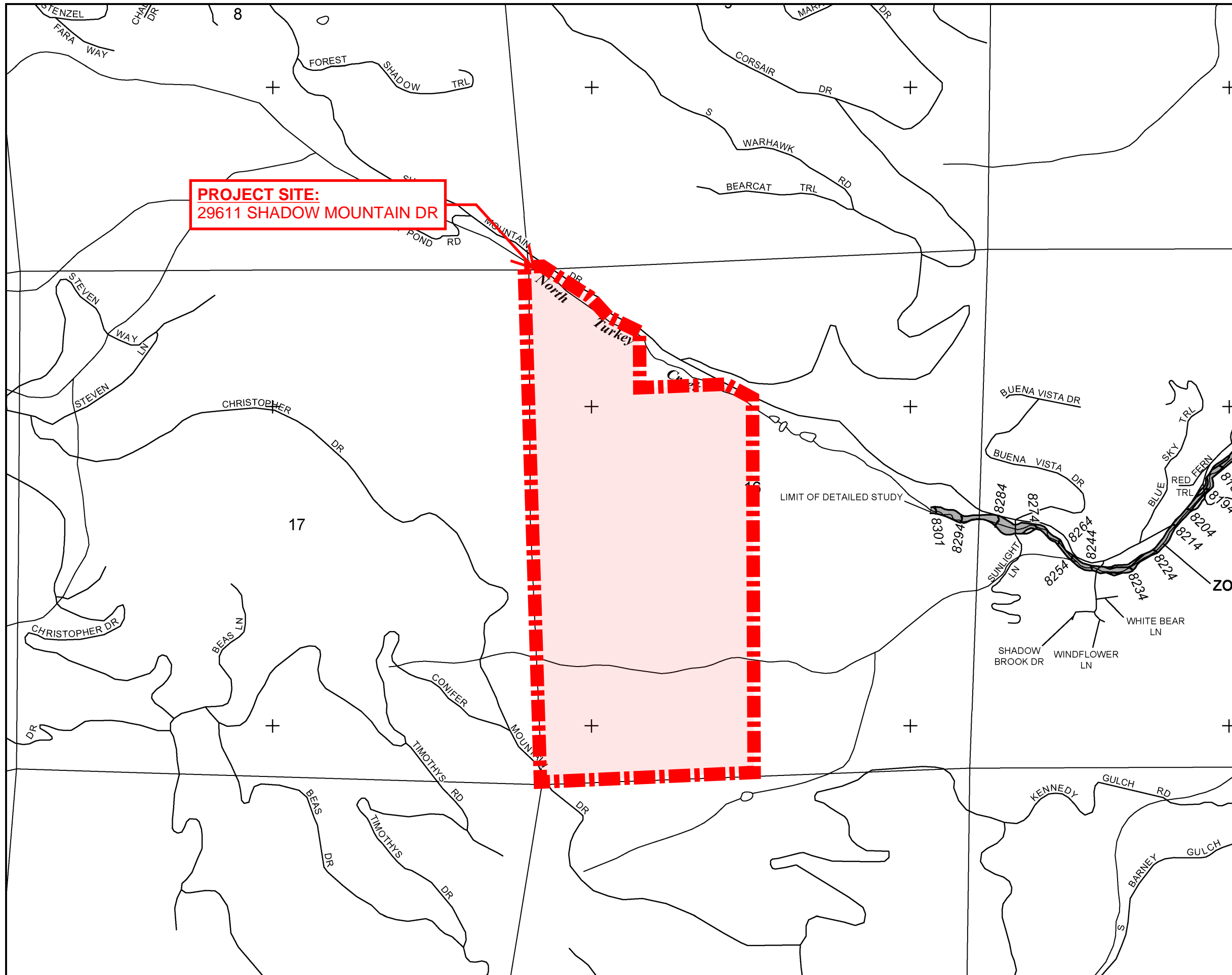
APPENDIX C – SOILS SURVEY

APPENDIX D – SITE SUB-BASIN RATIONAL CALCULATIONS

APPENDIX E – PRELIMINARY DETENTION BASIN CALCULATIONS

DPE – GENERAL LOCATION MAP

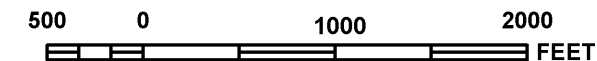
DPP – DEVELOPED DRAINAGE PLANS



PROJECT SITE:
29611 SHADOW MOUNTAIN DR



MAP SCALE 1" = 1000'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0365F

FIRM
FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 365 OF 675
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	08087	0365	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



MAP NUMBER
08059C0365F
MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at <https://msc.fema.gov>.

Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed, Jefferson County, Colorado, 1998–2001

By Clifford R. Bossong, Jonathan Saul Caine, David I. Stannard,
Jennifer L. Flynn, Michael R. Stevens, and Janet S. Heiny-Dash

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 03–4034

SHADOW MOUNTAIN BIKE PARK - PHASE I DRAINAGE REPORT

Only sections of this report as they apply to the project site for the proposed Shadow Mountain Bike Park are included to be used as reference only. A full report can be located at <https://pubs.usgs.gov>

Prepared in cooperation with the
JEFFERSON COUNTY PLANNING AND ZONING DEPARTMENT

Denver, Colorado
2003

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

The use of firm, trade, and brand names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

For additional information write to:

District Chief
U.S. Geological Survey
Box 25046, Mail Stop 415
Denver Federal Center
Denver, CO 80225-0046

Copies of this report can be purchased
from:

U.S. Geological Survey
Information Services
Box 25286
Denver Federal Center
Denver, CO 80225

CONTENTS

Glossary of Special Terms	IX
Abstract	1
Introduction	2
Purpose and Scope	3
Location and Setting	3
Previous Investigations	3
Acknowledgments	3
Geologic Framework	5
Data Collection and Methods	9
Historical Data	9
Contemporary Data	13
Fracture Characteristics	13
Outcrop Selection	14
Methods of Fracture Measurement	14
Climatologic Data	14
Surface-Water Data	20
Ground-Water Data	20
Water-Quality Data	21
Runoff Modeling Methods	27
General Characteristics of the Precipitation-Runoff Modeling System	29
Watershed Characterization Using the Precipitation-Runoff Modeling System	30
Hydrologic Conditions	32
Evapotranspiration	32
Forest Site Results	32
Meadow Site and Comparison to Forest Site	40
Surface-Water Conditions	46
Watershed Conditions	46
Intrawatershed Conditions	48
Ground-Water Conditions	51
Time-Series Water Levels	51
Synoptic Water Levels	57
Analysis of State Engineer Well-Construction Data	58
Univariate Statistics	58
Variogram Analysis	61
Water-Quality Characteristics in the Turkey Creek Watershed	63
General Water-Quality Characteristics	63
Comparison to Historical Water-Quality Data	72
Tritium	73
Chloride to Bromide Ratios	74
Wastewater Compounds	75
Chloride Sources	76
Seasonality of Specific Conductance	77
Assessment of Water Resources	79
Estimates of Potential Fracture-Network Porosity	79
Runoff Modeling	83
Hydrologic Response Unit Delineation and Parameterization	83
Interflow and Base-Flow Reservoir Delineation and Parameterization	88
Distribution of Precipitation and Temperature Data	89
Model Calibration	90
Watershed Calibration Procedures	91
Intrawatershed Calibration Procedures	92
Final Calibration	92

Contemporary Simulations	92
Long-Term Simulations	102
Simulation Results and Their Implications to Water Supply	106
Summary	117
Selected References	120
Appendix	125
Brittle Structures of the Turkey Creek Watershed	127
Fracture Data Analysis, Model Construction, and Matching Models to Data	128
Fracture Set Designation	129
Fracture Length Simulation	130
Fracture Spacing	130
Fracture Intensity and Calibration of Fracture Network Models to Field Data	130
Spatial Analysis of Well-Construction Data and Ground-Water Levels	131
Evapotranspiration Measurement Methods	132
Quality Assurance and Quality Control	134
Milliequivalent Balances	134
Quality-Control Samples	135
Duplicate Samples	137

FIGURES

1–8. Maps showing:	
1. Location of Turkey Creek watershed in Jefferson County, Colorado; identifier and locations for sites with specific-conductance measurement; and location of Bailey, Cheesman, and Elk Creek climatologic monitoring stations	4
2. Compilation of parts of the existing Evergreen, Indian Hills, Morrison, Conifer, and Meridian Hills U.S. Geological Survey Geologic Quadrangle Maps	6
3. Simplified geologic map, locations of outcrops where fracture characteristics were measured or observed, and fracture-orientation data for measurements at each location	7
4. Locations of surface-water streamflow measurement and sampling sites, stream gages, and irrigation ditches	11
5. Locations of permitted wells from the State Engineers Office	12
6. Spatial distribution of water-quality samples collected in previous studies in the Turkey Creek watershed	13
7. Location of climatologic monitoring sites	15
8. Schematic of the energy balance of a vegetated surface	16
9. Photograph of eddy-correlation evapotranspiration tower at forest site	19
10. Photograph of Bowen-ratio evapotranspiration tripod at meadow site	21
11. Map showing locations of water-level monitoring wells	23
12. Map showing location of ground-water sampling sites	27
13. Schematic diagram of selected physical processes characterized by Precipitation-Runoff Modeling System	31
14–22. Graphs showing:	
14. Daily evapotranspiration at forest site during (A) 1999, (B) 2000, and (C) 2001	33
15. Daily precipitation and daily mean soil moisture at forest site during (A) 1999, (B) 2000, and (C) 2001	34
16. Daily mean solar radiation at forest site during (A) 1999, (B) 2000, and (C) 2001	35
17. Annual precipitation and infiltration at forest site during the study period	38
18. Daily precipitation and cumulative infiltration at forest site during (A) 1999, (B) 2000, and (C) 2001	39
19. Daily evapotranspiration at meadow and forest sites during (A) 2000 and (B) 2001	41
20. Daily precipitation at meadow site, and daily mean soil moisture at meadow and forest sites during (A) 2000 and (B) 2001	42
21. Daily mean solar radiation at meadow site during (A) 2000 and (B) 2001	43
22. Streamflow hydrographs for the three stream gages on Turkey Creek and annual precipitation at the Cheesman site	47

23.	Map showing locations of short-term record stream gages and sites of synoptic streamflow measurements.....	51
24.	Hydrographs from short-term records of streamflow (<i>A</i> , log; <i>B</i> , arithmetic)	52
25–29.	Graphs showing:	
25.	Ground-water fluctuations in water-level monitoring wells.....	54
26.	Ground-water table in the Turkey Creek watershed, September 2001	58
27.	Contours of depth to ground water for September 2001	59
28.	Well yield and total depth for State Engineers Office permitted wells	63
29.	Variogram surface maps	64
30.	Stiff diagrams of selected water-quality constituents in the Turkey Creek watershed	69
31.	Trilinear diagram of quarterly ground-water and surface-water samples collected in the Turkey Creek watershed.....	70
32–35.	Maps showing:	
32.	Specific-conductance measurements in ground- and surface-water samples.....	71
33.	Concentrations of chloride in ground- and surface-water samples	72
34.	Concentrations of nitrate plus nitrite in ground- and surface-water sample.....	73
35.	Concentrations of boron in ground- and surface-water samples	74
36–38.	Graphs showing:	
36.	Plot of tritium concentrations in precipitation interpolated to Turkey Creek watershed location and decayed to year 2000 values, and boxplot of tritium concentrations in selected water wells in the Turkey Creek watershed.....	75
37.	Time-series plot of Turkey Creek watershed hydrologic variables and seasonal specific-conductance measurements collected at selected wells in fall 2000 and spring 2001	78
38.	Correlation of specific conductance and streamflow and time-series plot showing seasonal variation of specific conductance and streamflow at Turkey Creek at mouth of canyon near Morrison	80
39.	Boxplot showing distribution of specific conductance at Turkey Creek at mouth of canyon (site A) and six comparison sites	82
40.	Graph showing plot of the log of total fracture model potential porosity for each locality.....	83
41.	Map showing Hydrologic Response Units delineated for use with the Precipitation-Runoff Modeling System in the Turkey Creek watershed	85
42.	Map showing interflow and base-flow reservoirs delineated for use with the Precipitation-Runoff Modeling System in the Turkey Creek watershed	89
43–45.	Graphs showing:	
43.	Watershed hydrographs of contemporary simulated and measured results.....	93
44.	Intrawatershed hydrographs of contemporary simulated and measured results.....	96
45.	Watershed hydrographs of long-term simulated results	107

APPENDIX FIGURE

A1.	Flow chart showing how discrete fracture-network model parameters are modeled to lead to the construction of a single best-fit model.....	129
-----	---	-----

TABLES

1.	Individual rock types assigned to rock groups in the Turkey Creek watershed.....	8
2.	List of sites with time-series records	10
3.	Univariate statistics for water-quality properties and constituents collected in previous studies.....	14
4.	Sensor type, data loggers, sensor heights, and measured variables at forest site	18
5.	Sensor type, heights, and measured variables at meadow site.....	20
6.	Site identifiers and selected characteristics for sites of surface-water-quality samples, short-term streamflow records, and synoptic streamflow measurements in the Turkey Creek watershed, Jefferson County, Colorado, 1998–2001	22
7.	Well-construction details and miscellaneous data for ground-water level monitoring wells in the Turkey Creek watershed, Jefferson County, Colorado, 1998–2001.....	24

8. Site identifiers and selected characteristics for ground-water-quality sampling sites in the Turkey Creek watershed, Jefferson County, Colorado, 1998–2000.....	25
9. Water-quality properties and constituents included in analyses in water year 1999.....	28
10. Miscellaneous data collected in water year 2001, including analysis results for bromide, selected inorganic ions, wastewater compounds, and tritium	29
11. Climatic and water balance summary for calendar years 1999, 2000, 2001, and 3-year mean, at forest site	36
12. Climatic and water balance summary for calendar year 2001 at meadow and forest sites.....	44
13. Streamflow statistics for Turkey Creek.....	49
14. Measured precipitation and streamflow in and near the Turkey Creek watershed	50
15. Synoptic measurements of streamflow made at rock group sites and surface-water sampling sites	53
16. Univariate statistics and correlations for well-construction characteristics	60
17. Descriptive statistics for selected physical characteristics of permitted wells from the State Engineers Office, by rock group	61
18. Univariate statistics for reported well yields by rock type and group and through time	62
19. Univariate statistics for water-quality properties and constituents in selected ground-water samples collected September 1998 through November 1999.....	65
20. Univariate statistics for water-quality properties and constituents in selected surface-water samples collected September 1998 through November 1999.....	67
21. Specific-conductance data summary for Turkey Creek at mouth (site A) and eight comparison sites on the eastern slope of the Rocky Mountains in Colorado	81
22. Turkey Creek watershed hydrologic parameter estimates from previous work.....	82
23. Turkey Creek watershed fracture-model potential porosity results	84
24. Summary of Hydrologic Response Unit and base-flow reservoir characteristics, and hydrologic response unit accounting for contemporary simulation in the Turkey Creek watershed	86
25. Monthly means and selected summary statistics for measured precipitation	90
26. Watershed and intrawatershed calibration statistics.....	95
27. Monthly and annual summary statistics for contemporary simulations (January 1, 1999, through September 30, 2001) for the entire Turkey Creek watershed.....	97
28. Intrawatershed summary statistics for contemporary simulations (January 1, 1999, through September 30, 2001) for areas of (A) metamorphic, (B) intrusive, and (C) fault-zone rocks and (D) Pikes Peak Granite.....	98
29. Summary statistics of daily values for water-balance terms from contemporary simulations in (A) the entire Turkey Creek watershed and for areas of (B) metamorphic, (C) intrusive, and (D) fault-zone rocks and (E) Pikes Peak Granite	102
30. Annual summary statistics for long-term simulations (October 1, 1948, through September 30, 1999) in the entire Turkey Creek watershed.....	108
31. Intrawatershed summary statistics for long-term simulations (October 1, 1948, through September 30, 1999) for areas of (A) metamorphic, (B) intrusive, and (C) fault-zone rocks and (D) Pikes Peak Granite in the Turkey Creek watershed	109
32. Summary statistics of daily values for water-balance terms from long-term simulations for (A) the entire Turkey Creek watershed and for areas of (B) metamorphic, (C) intrusive, and (D) fault-zone rocks and (E) Pikes Peak Granite	113

APPENDIX TABLES

A1. Frequency distribution for milliequivalent balances	135
A2. List of detections in quality-control samples	136
A3. Statistics for relative percent differences in duplicate samples.....	137
A4. Selected site characteristics for water levels measured in fall 2001	138

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

	Multiply	By	To obtain
Length			
	inch	2.54	centimeter (cm)
	inch	25.4	millimeter (mm)
	foot (ft)	0.3048	meter (m)
	mile (mi)	1.609	kilometer (km)
Area			
	acre	4,047	square meter (m ²)
	acre	0.004047	square kilometer (km ²)
	square mile (mi ²)	2.590	square kilometer (km ²)
	square mile (mi ²)	640	acre
Volume			
	liter (L)	0.2642	gallon
	acre-foot (acre-ft)	1,233	cubic meter (m ³)
	acre-foot (acre-ft)	0.001233	cubic hectometer (hm ³)
Flow			
	cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m ³ /s)
	cubic foot per second per square mile [(ft ³ /s)/mi ²]	0.01093	cubic meter per second per square kilometer [(m ³ /s)/km ²]
	gallon per minute (gal/min)	0.06309	liter per second (L/s)
Power			
	watt	1	joules per second

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F} = 1.8 (^{\circ}\text{C}) + 32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) / 1.8$$

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929. Horizontal is referenced to the North American Datum of 1927.

Elevation, as used in this report, refers to distance above or below NGVD29. NGVD29 can be converted to the North American Vertical Datum of 1988 by using the the National Geodetic Survey Conversion Utility available at URL <http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html>

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Additional Abbreviations

mL	milliliter
m ² /m ³	square meter per cubic meter
g m ⁻² s ⁻¹	gram per square meter per second
Wm ⁻²	watt per square meter
kPa	kilopascal
J	joule
min	minute

GLOSSARY OF SELECTED TERMS

The following terms are defined as they are used in this report.

Aperture.—The width of individual fracture openings in rock. Aperture is measured across the fracture, perpendicular to the fracture length.

Base flow.—Streamflow that emanates from ground water contained in a conceptual base-flow reservoir that exists in the subsurface. It is base flow that typically sustains streamflow during rainless periods.

Brittle structures.—Fractures, joints, and faults in rocks that are the result of brittle rather than ductile deformation.

Contemporary.—This term is used in this report to indicate data that were collected as part of this study, or to indicate methods that were applied to data that were collected for this study.

Evapotranspiration.—The process of moisture moving from the surface and near-surface areas of the Earth to the atmosphere; it is the sum of evaporation from wet surfaces (leaves, wet soils and rock, surface-water bodies, for example), sublimation from snow or ice, and transpiration, which is water evaporated from plant stomates.

Fracture set.—A group of fractures that have a set of properties such as orientation or length, or both, that are similar.

Fracture network.—A group of fracture sets that comprise all of the fractures in a volume of rock.

Fracture porosity.—Porosity resulting from open fractures, faults, or cracks.

Ground water.—As used in this report, water in the subsurface under water-table conditions. Some unknown amount of ground water is not associated with local streamflow. As used in this report, ground water represents the contents of interflow and base-flow reservoirs and additional unaccounted for ground water that is not associated with local streamflow.

GSNK.—Ground water that percolates to a conceptual area of the watershed that is not available to support local streamflow.

Hydrologic response unit (HRU).—A land surface with similar slope and aspect properties defined for modeling surface and near-surface hydrologic processes.

Interflow.—Streamflow that emanates from ground water in direct response to precipitation or snowmelt, or both, that is contained in a conceptual interflow reservoir in the subsurface. Interflow may consist of streamflow contributions from subsurface areas that are saturated or perched, or some combination of both.

Interflow and base-flow reservoirs.—Conceptual subsurface portions of the watershed used for accounting purposes in runoff modeling.

Overland flow.—That part of precipitation that passes over the surface of the land and into the nearest surface-water body without first passing beneath the surface. Generally in direct response to precipitation.

Potential porosity.—An estimate of porosity made on the basis of mathematical characterizations of outcrop fracture measurements extrapolated to rock groups.

Recharge.—As used in this report, water added to the subsurface below the soil zone; it is the residual of precipitation, evapotranspiration, and overland flow. Recharge supports interflow, base flow, and underflow.

Rock group.—An assemblage of mappable rock types aggregated into a group on the basis of similarities.

Transmissivity.—Rate of movement of a volume of fluid through a medium. Units of measurement are L^2/T , where L is length and T is time.

Underflow.—Ground water that leaves the watershed by means other than streamflow or evapotranspiration.

Hydrologic Conditions and Assessment of Water Resources in the Turkey Creek Watershed, Jefferson County, Colorado, 1998–2001

By Clifford R. Bossong, Jonathan Saul Caine, David I. Stannard, Jennifer L. Flynn, Michael R. Stevens, and Janet S. Heiny-Dash

Abstract

The 47.2-square-mile Turkey Creek watershed, in Jefferson County southwest of Denver, Colorado, is relatively steep with about 4,000 feet of relief and is in an area of fractured crystalline rocks of Precambrian age. Water needs for about 4,900 households in the watershed are served by domestic wells and individual sewage-disposal systems. Hydrologic conditions are described on the basis of contemporary hydrologic and geologic data collected in the watershed from early spring 1998 through September 2001. The water resources are assessed using discrete fracture-network modeling to estimate porosity and a physically based, distributed-parameter watershed runoff model to develop estimates of water-balance terms.

A variety of climatologic and hydrologic data were collected. Direct measurements of evapotranspiration indicate that a large amount (3 calendar-year mean of 82.9 percent) of precipitation is returned to the atmosphere. Surface-water records from January 1, 1999, through September 30, 2001, indicate that about 9 percent of precipitation leaves the watershed as streamflow in a seasonal pattern, with highest streamflows generally occurring in spring related to snowmelt and precipitation. Although conditions vary considerably within the watershed, overall watershed streamflow, based on several records collected during the 1940's, 1950's, 1980's, and 1990's near the downstream part of watershed, can be as high as about 200 cubic feet per

second on a daily basis during spring. Streamflow typically recedes to about 1 cubic foot per second or less during rainless periods and is rarely zero. Ground-water level data indicate a seasonal pattern similar to that of surface water in which water levels are highest, rising tens of feet in some locations, in the spring and then receding during rainless periods at relatively constant rates until recharged. Synoptic measurements of water levels in 131 mostly domestic wells in fall of 2001 indicate a water-table surface that conforms to topography. Analyses of reported well-construction records indicate a median reported well yield of 4 gallons per minute and a spatial distribution for reported well yield that has relatively uniform conditions of small-scale variability. Results from quarterly samples collected in water year 1999 at about 112 wells and 22 streams indicate relatively concentrated calcium-bicarbonate to calcium-chloride type water that has a higher concentration of chloride than would be expected on the basis of chloride content in precipitation and evapotranspiration rates. Comparison of the 1999 data to similar data collected in the 1970's indicates that concentrations for many constituents appear to have increased. Reconnaissance sampling in the fall of 2000 indicates that most ground water in the watershed was recharged recently, although some ground water was recharged more than 50 years ago. Additional reconnaissance sampling in the spring and fall of 2001 identified some compounds indicative of human wastewater in ground water and surface water.

Outcrop fracture measurements were used to estimate potential porosities in three rock groups (metamorphic, intrusive, and fault zone) that have distinct fracture characteristics. The characterization, assuming a uniform aperture size of 100 microns, indicates very low potential fracture porosities, on the order of hundredths of a percent for metamorphic and intrusive rocks and up to about 2 percent for fault-zone rocks. A fourth rock group, Pikes Peak Granite, was defined on the basis of weathering characteristics. Short-term continuous and synoptic measurements of streamflow were used to describe base-flow characteristics in areas of the watershed underlain by each of the four rock groups and are the basis for characterization of base flow in a physically based, distributed-parameter watershed model.

The watershed model, the Precipitation-Runoff Modeling System (PRMS), was used to characterize hydrologic conditions on the basis of precipitation and air temperature in 112 hydrologic response units for which physical characteristics were derived from mostly digital data. The watershed model also was used to characterize hydrologic conditions in subsurface portions of the watershed that are associated with streamflow. The model was conditioned, using a relatively small set of parameters, to match measurements of watershed and intrawatershed streamflow and point measurements of evapotranspiration, air temperature, and soil moisture. Results from the watershed model provide simulated estimates for water-balance terms in a contemporary simulation (January 1, 1999, through September 30, 2001) using precipitation and adjusted temperature data from within the watershed, and in a long-term simulation (October 1, 1948, through September 30, 1999) using precipitation and temperature data from near the watershed. The results of both simulations indicate that, on a watershed scale, base-flow reservoirs consistently contain about enough water to cover the watershed with 0.1 to 0.2 inch of water. The long-term simulations indicate that during a year with about 14 inches of precipitation, the watershed base-flow reservoir may have about a -0.06 inch

change in contents during periods with relatively small amounts of recharge. The results from watershed simulations also indicate that contents of base-flow reservoirs vary within the watershed; base-flow reservoirs contain little or no recoverable water for significant portions of many years in about 90 percent of the watershed. In areas where base-flow reservoirs contain no water, the only source of water for wells is water that has percolated to relatively deep parts of the system that are not associated with local streamflow; water withdrawn under these conditions will need to be replaced before base flow can resume. Estimates of the amount of water withdrawn by wells in 2001 in the Turkey Creek watershed are equal to a watershed depth of about 0.43 to 0.65 inch (about 0.0012 to 0.0018 inch per day).

INTRODUCTION

Water quality, water quantity, and population growth in the foothill portions of Jefferson County are of concern to the Jefferson County Board of County Commissioners and the Planning and Zoning Department. The Planning and Zoning Department desires to meet the needs of current residents for adequate supplies of good quality water and to prepare for the projected growth and demands on the water resource from future development. The Turkey Creek watershed is representative of the foothills portions of Jefferson County. Contemporary (2001) population in the Turkey Creek watershed is estimated at 11,064 residents with projected population growth, using a 2-percent per year rate, at 13,186 residents in 2010, and 15,313 residents in 2020 (Jefferson County Planning and Zoning Department, written commun., 2001).

Water supply in the foothills portions of Jefferson County is typically derived from domestic wells developed in the fractured crystalline rocks. There are many anecdotal reports of wells “going dry” or requiring modifications to maintain production, and the prospect of continued development raises some questions regarding water supply. In addition, domestic water is treated in individual sewage-disposal systems (ISDS) and returned to the local system as ISDS effluent from leach fields, and this has raised some concerns regarding the quality of water.

An understanding of hydrologic processes, especially those related to ground water, is a fundamental step in assessing contemporary (2001) quality and quantity of ground water. Together, the U.S. Geological Survey (USGS) and Jefferson County undertook a cooperative study of hydrologic conditions and assessment of water resources in Turkey Creek watershed beginning in 1998.

Purpose and Scope

The purpose of this report is to describe contemporary (2001) hydrologic conditions and to provide a hydrologic assessment of water resources in the Turkey Creek watershed. Hydrologic conditions are described on the basis of evapotranspiration, surface water, ground water, and water quality. In addition, a description of rock-fracture characteristics based on outcrop-scale measurements is included. The watershed assessment includes estimates of fracture porosity and a characterization of water-balance terms using a watershed precipitation-runoff model.

The scope of the study includes historical climatologic data collected by study-area residents, contemporary data collected during the study from 1998 to 2001, and historical data from agencies such as the Colorado Climate Center, State Engineers Office (SEO), and the USGS. Various methods, including geologic mapping and precipitation-runoff modeling, were used to assess water resources in the study area.

Location and Setting

The study area is the 47.2-mi² Turkey Creek watershed (fig. 1), in Jefferson County southwest of Denver, Colo., in the foothills of the Front Range Section of the Southern Rocky Mountains physiographic province (Fenneman, 1931). Included in the study area are many developed areas such as Conifer, Aspen Park, and Indian Hills. It is estimated that there are about 4,900 households in the study area, or, on average, about one household for every 6 acres (Jefferson County Planning and Zoning Department, written commun., 2001). About 62 percent of households in the watershed are single-family detached homes.

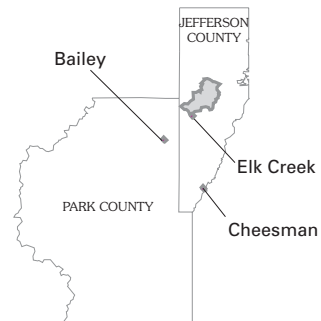
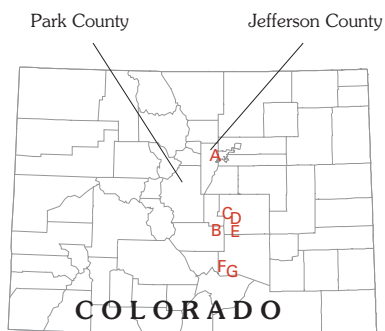
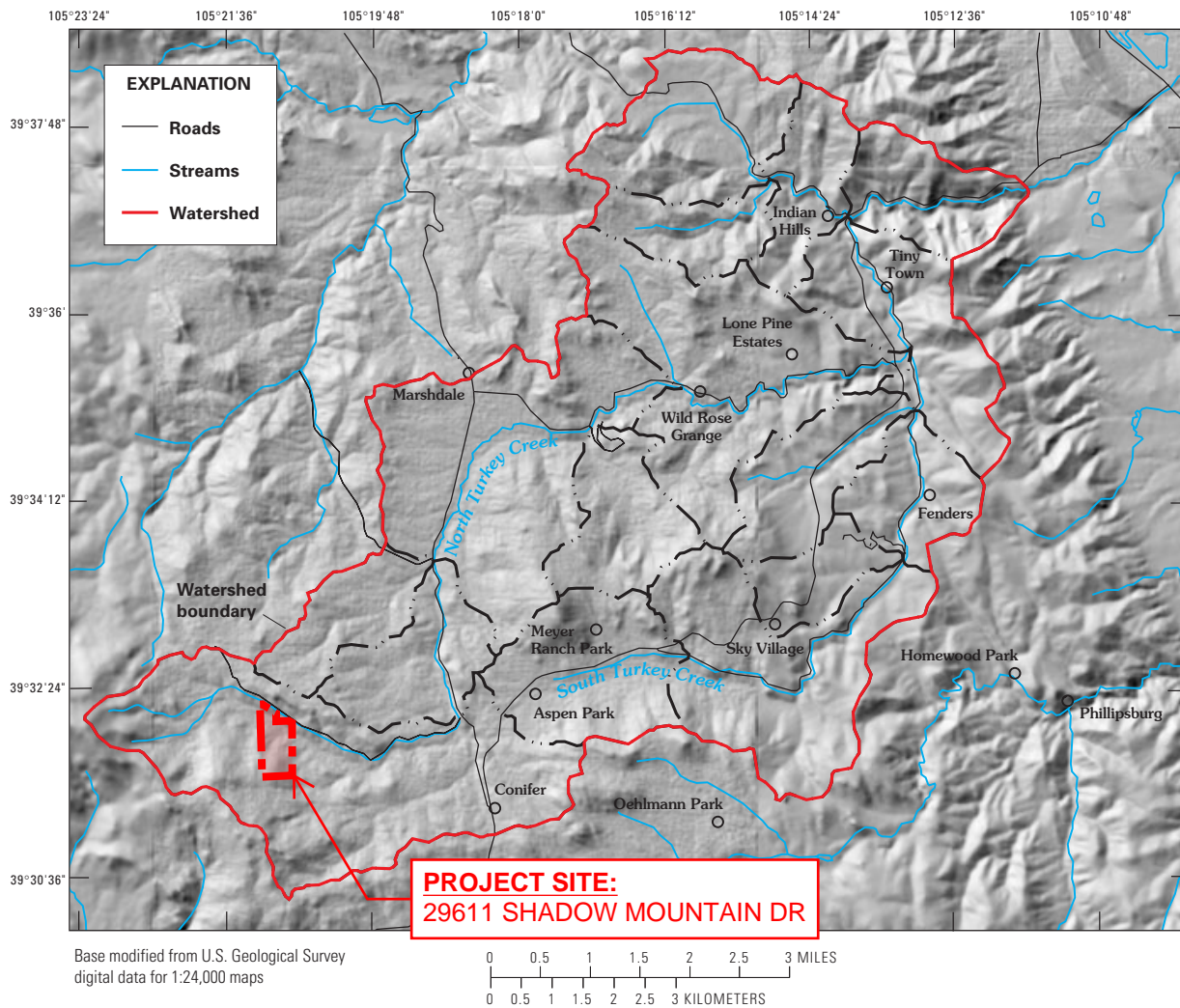
The watershed topography is mostly steep and often rocky with elevations ranging from about 10,500 ft in the southwestern part of the watershed to about 6,000 ft at the mouth of Turkey Creek canyon where the stream exits the foothills. Numerous bedrock outcrops in the study area border relatively gentle, open parks, such as Aspen Park, and stream valleys, such as North and South Turkey Creeks. Bedrock consists of fractured igneous and metamorphic crystalline rocks of Precambrian age that are extensively deformed. A more detailed geologic description is presented in the “Geologic Framework” section.

Previous Investigations

Several previous studies have been done on the chemical quality and physical quantity of the water resource in the Turkey Creek watershed. Snow (1968, 1972) and Waltz (1972) discussed the importance of fractured-bedrock aquifer characteristics in influencing the ground-water flow regime. Hofstra and Hall (1975a, 1975b) collected, compiled, and analyzed water-quality data for Phase I of an investigation to determine the effects of development on the water availability, water quality, and controlling factors in several mountain communities. Phase II of that investigation (Hall and Johnson, 1979) indicated that, although water quality was degrading, it was still acceptable for drinking. Seasonal fluctuations in water levels were observed (Hall and Johnson, 1979), and over a 3-year period there was an overall decline in water levels that may reflect short-term climatological factors or increased withdrawal from ground water. Recent work by Bruce and McMahon (1997) and Stevens and others (1997) provides water-quality data from the Turkey Creek watershed and other Front Range mountainous settings that can be compared to the results of this study.

Acknowledgments

The authors thank various local, State, and Federal agencies for their cooperation in providing information and data that were used in preparing this report, specifically the Colorado Department of Public Health and Environment; Colorado Division of Water Resources; Jefferson County Board of Commissioners; Jefferson County Planning and Zoning Department;



EXPLANATION

- C Site with specific-conductance measurement

Figure 1. Location of Turkey Creek watershed in Jefferson County, Colorado; identifier and locations for sites with specific-conductance measurement; and location of Bailey, Cheesman, and Elk Creek climatologic monitoring stations.

members of the Mountain Ground-Water Resource Study Steering Committee; and the U.S. Environmental Protection Agency, Region VIII. Thanks also to Stephanie R.A. Tomusiak, Department of Geological Sciences, University of Colorado, Boulder, for her contributions to the fracture-data collection, analyses, and modeling efforts. Field assistance for outcrop measurements of fracture characteristics was provided by Ari Menitove, Jessica Beck, Sonya Cadle, Ben Glass, David Gardner, and Jared Lewis. Special appreciation also is expressed to Dick Burrows and Dorothy Hatch, dedicated volunteers that made monthly water-level measurements throughout the watershed during the study, as well as individuals who collected precipitation data, and homeowners who allowed various activities on their property such as water-level measurements, precipitation measurements, access to outcrops for fracture measurements, access to stream-sampling sites, and ground-water sample collection.

GEOLOGIC FRAMEWORK

A compilation of existing USGS geologic quadrangle maps for the Turkey Creek watershed shows a complex arrangement of Precambrian-age crystalline metamorphic and intrusive rock types (fig. 2 and table 1; Char, 2000, modified from Sheridan and others, 1972; Bryant and others, 1973; Scott, 1972; Bryant, 1974). Figure 3 is a simplified version of the geology shown in figure 2 and the rock types in table 1, produced by combining individual rock types into rock groups. Rock groups were identified on the basis of lithologic similarity, structural history, and geologic setting. For each rock group it is assumed that (1) ground-water flow and storage predominantly occurs in fracture networks, and that (2) because each rock group is composed of similar rock types that have a similar geological history and response to brittle deformation, they will exhibit similar hydrogeological properties (for example, porosity). Three important rock groups that contain subgroups were used to aid in establishing a geologic and hydrologic framework model. The rock groups are (1) metamorphosed and foliated gneisses and schists, referred to as the “metamorphic rock group;” (2) large-scale intrusive quartz monzonites found in plutons and consisting mostly of the Silver Plume Quartz Monzonite, referred to as the “intrusive rock group;” and (3) major fault zones that cut all rock types, referred to as the “fault-zone rock group” (fig. 3). Further division of the metamorphic and intrusive rock

groups results in three subgroups: (1a) amphibolites, calc-silicates, and quartzites, (2a) the Pikes Peak Granite, and (2b) granitic pegmatite dikes that cross-cut the metamorphic and intrusive rock groups (table 1). The metamorphic, intrusive, and fault-zone rock groups plus subgroup 2a (the Pikes Peak Granite) are collectively referred to as the “four rock groups” in this report; group 1a is included in the metamorphic rocks and group 2b is included in the intrusive rocks.

The major rock types include approximately 1.7-billion-year-old gneisses and schists (metamorphic rocks). These rocks are typically well layered due to original compositional variations and metamorphic processes (Bryant, 1974; Bryant and others, 1975). They are part of the Turkey Creek Formation and are similar to the rocks in the Idaho Springs Formation (Lickus and LeRoy, 1968). The metamorphic rocks are intruded or cut by the approximately 1.4-billion-year-old Silver Plume Quartz Monzonite, which is a rock type similar to granite (intrusive rocks) (Bryant, 1974). These intrusive rocks are heterogeneously distributed in the watershed. The intrusive bodies range in size from small, dike-like features 50–100 ft long to large and irregular pluton-like bodies with large apophyses miles long. Pegmatitic dikes also cut the intrusive rocks. The pegmatites are highly irregular in shape and size and are less than a few feet to several miles long.

The major geologic structures in the watershed include folds and fault zones. The layering in the metamorphic rocks is generally steeply to moderately tilted and generally strikes northwest to southeast. This tilting is associated with the proximity of the observed outcrops to the limbs of several regional scale folds (Bryant and others, 1973). Many local-to outcrop-scale folds and highly contorted layering zones are present throughout the watershed.

A variety of brittle fault structures or fault zones are present in the watershed (fig. 3), and the Appendix contains a detailed discussion of these features. Brittle fault zones are in the form of unusually wide fracture networks (tens of feet to greater than miles wide) where most of the zone is composed of open fractures with little offset on them and a few discrete fractures where most of the offset has occurred. Other brittle fault zones are relatively narrow (a few feet wide) fault breccia zones that have anastomosing and discrete fractures where motion has taken place and where fracture networks have been mineralized with quartz, calcite, and other associated minerals.

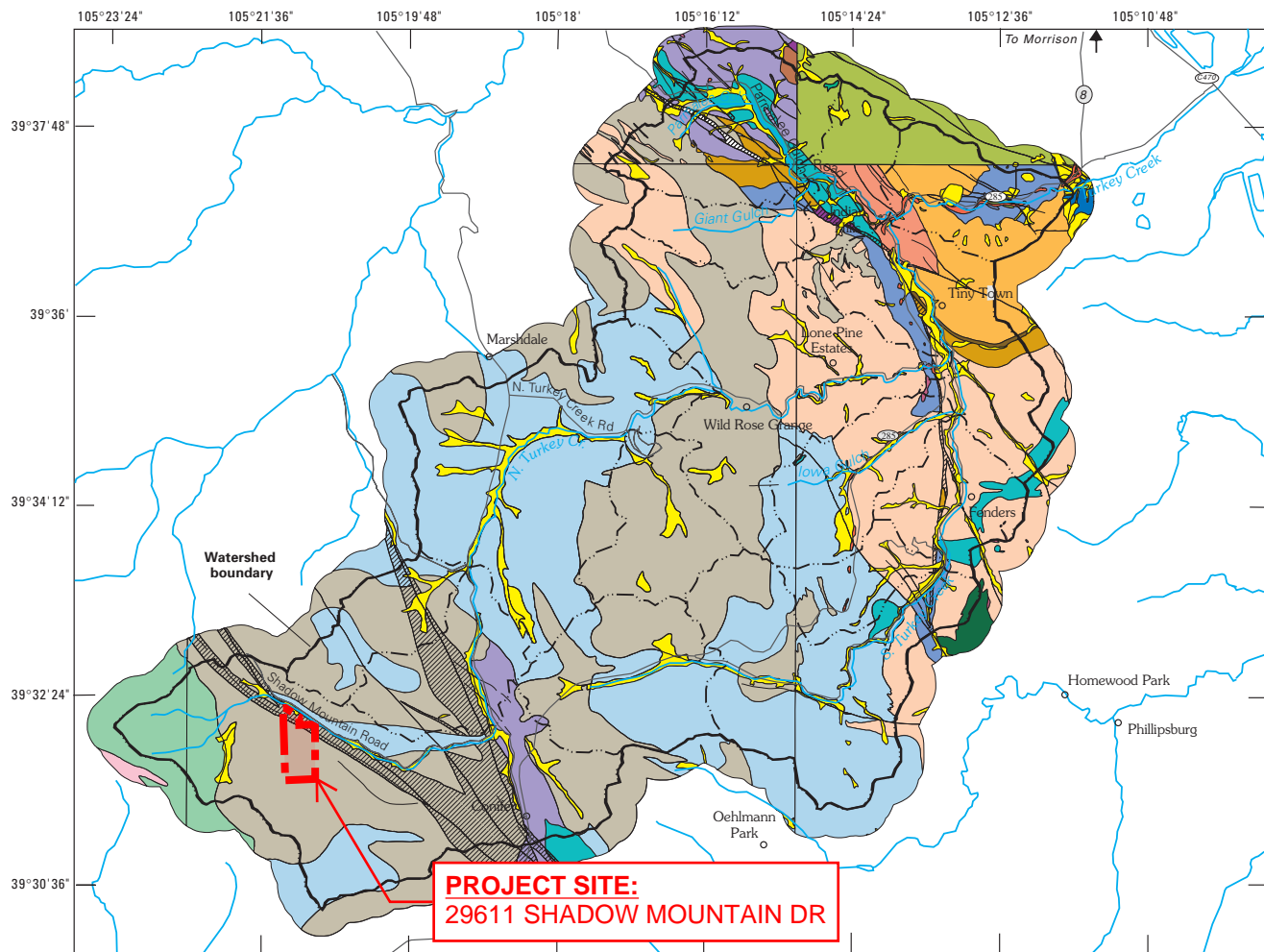


Figure 2. Compilation of parts of the existing Evergreen, Indian Hills, Morrison, Conifer, and Meridian Hills U.S. Geological Survey Geologic Quadrangle Maps.

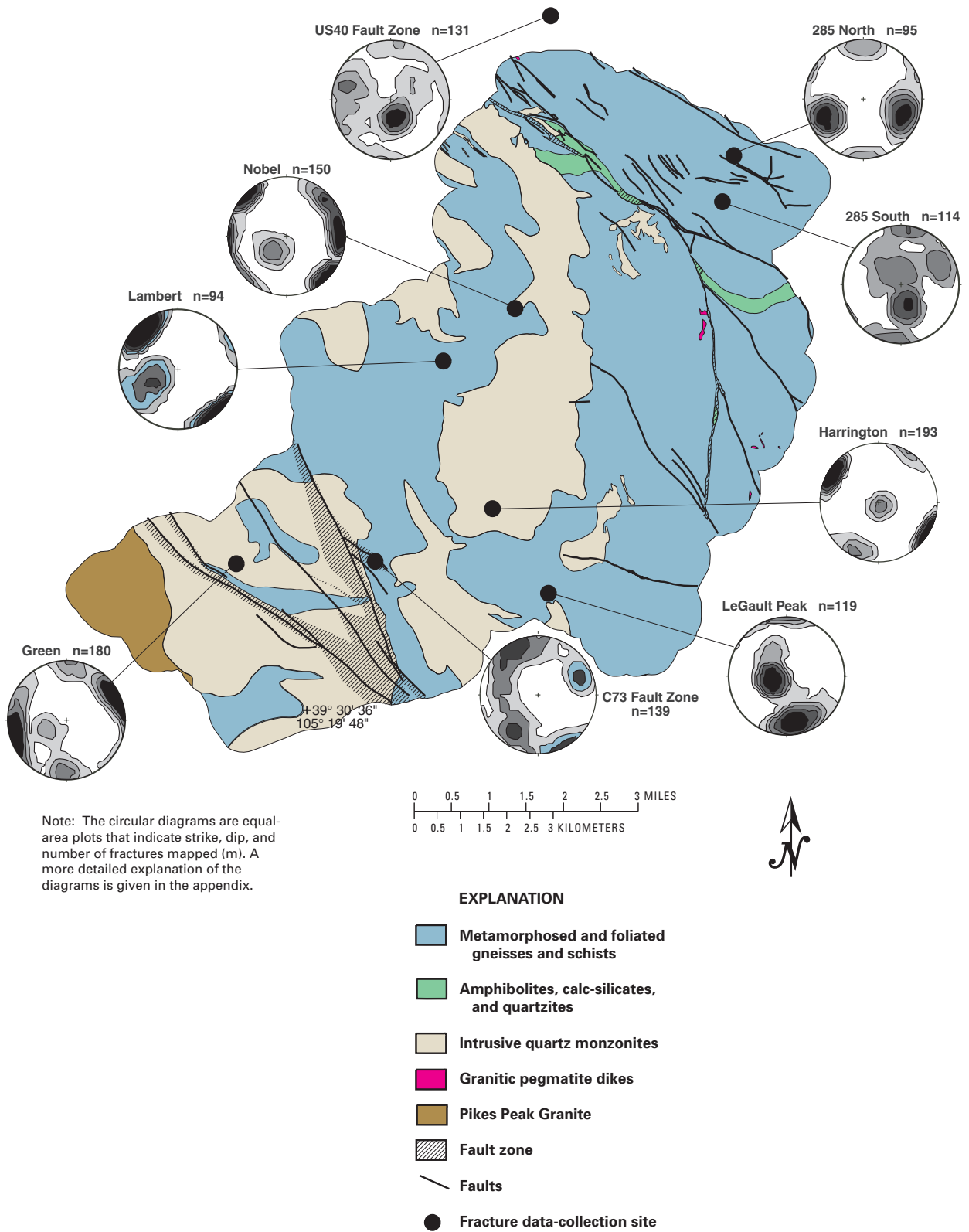


Figure 3. Simplified geologic map, locations of outcrops where fracture characteristics were measured or observed, and fracture-orientation data for measurements at each location.

Table 1. Individual rock types assigned to rock groups in the Turkey Creek watershed

[Individual rock types taken from the explanation in figure 2 are assigned to rock groups based on lithologic similarity, structural history, and geologic setting. The groups include (1) metamorphosed and foliated gneisses and schists; (1a) amphibolites, calc-silicates, and quartzites; (2) large-scale intrusive quartz monzonites found in plutons and consisting mostly of the Silver Plume Quartz Monzonite; (2a) Pikes Peak Granite and other granites; (2b) granitic pegmatites; and (3) major fault zones that cut all rock types. NP indicates rock types not present in the study area and Quaternary-age deposits have not been included. Y indicates Precambrian-age rocks that formed between 1.04 and 1.44 billion years ago, and X indicates rocks between 1.71 and 1.75 billion years old for this area. All other units are undated Precambrian-age rocks unless otherwise stated. The following is from Char, 2000, modified from Sheridan and others, 1972; Bryant and others, 1973; Scott, 1972; and Bryant, 1974]

Rock type name	Rock group assignment
Shonkinite	NP
Fountain Formation (Permian and Pennsylvanian-age sediments)	NP
Pikes Peak Granite	2a
Silver Plume Quartz Monzonite	2
Fine-grained porphyritic phase of Pikes Peak Granite	2a
Granitic rock	2a
Coarse-grained pegmatite	2b
Mafic granodiorite and quartz diorite	2
Gneissic granodiorite and quartz monzonite	1
Gneissic quartz monzonite	1
Migmatitic quartzo-feldspathic gneiss	1
Migmatite	1
Amphibolite, quartzite, marble, and associated rocks	1a
Amphibolite	1a
Biotite gneiss and associated rocks	1
Sillimanitic biotite gneiss containing garnet-bearing layers, and cordierite-feldspar-rich gneiss	1
Interlayered hornblende and calc-silicate gneiss and amphibolite	1a
Feldspar-rich gneiss	1
Garnet-mica gneiss	1
Well-foliated, medium-grained biotite-quartz monzonitic or granitic gneiss	1
Felsic gneiss	1
Rutile-bearing sillimanite quartzite	1a
Fault zone	3

The Colorado Rocky Mountain Front Range has a long and complex geologic history and associated brittle deformation. There are at least three generations of brittle deformation associated with the Precambrian rock in the watershed: (1) early Paleozoic-age burial and late Paleozoic-age Ancestral Rocky Mountain uplift, (2) mid- to late Mesozoic-age burial and late Mesozoic-age to early Cenozoic-age Laramide uplift, and (3) late Cenozoic-age volcanism, uplift, and possible extension (for example, Sonnenberg and Bolyard, 1997). This protracted geologic history and the response of the various rock types to deformation led to the complex joint (fractures with no shearing motion along them) and fault patterns that are observed today. The Turkey Creek watershed

represents a relatively undeformed portion of the Front Range relative to areas to the north in the Colorado Mineral Belt (Tweto and Sims, 1963).

Quaternary-age alluvium in the Turkey Creek watershed is sparse and is present primarily along stream channels and in open areas locally known as parks (fig. 2). The dominant soil types (stony loams to rock outcrops) are generally thin (about 2 to 3 ft thick), have generally low water availability, have moderate to high permeability, and are on moderate to steep slopes (U.S. Department of Agriculture, 1980). In addition, locally derived, very near-surface, bedrock weathering may be hydraulically significant. Thicker zones of weathered bedrock exist predominantly where there are coarse-grained intrusive rocks,

especially overlying the Pikes Peak Granite. Significant areas of weathered bedrock also occur where there are metamorphic rocks that are dominantly composed of hornblende and a variety of amphiboles. Field observations and anecdotal information from water-well drillers indicate that weathered bedrock is rare to absent except in the southwestern part of the watershed where the Pikes Peak Granite crops out (fig. 2). Weathering probably extends to depths of about 10 ft or less and is nonuniformly distributed where the Pikes Peak Granite crops out and in particular where it has been glaciated.

Surficial deposits of alluvium and soils are thin and not present everywhere in the Turkey Creek watershed; although the surficial deposits contain water, most wells in the watershed are completed in the crystalline bedrock and most water used for domestic supply in the watershed is withdrawn from the crystalline bedrock. The crystalline bedrock has very low primary, or intergranular, porosity; rather, open space that may contain water in the crystalline rocks consists mostly of fractures and fracture networks. The fractured bedrock aquifer system in the Turkey Creek watershed is the fractures and fracture networks in the crystalline rocks.

DATA COLLECTION AND METHODS

Data used as part of this study are described in this section. Data collected in previous USGS studies and data compiled or collected by other agencies are referred to as “historical data,” and data collected as part of this study, beginning in 1998 and continuing through September 2001, are referred to as “contemporary data.” Some of the methods used in analyzing these data also are described in this section. Detailed descriptions of specialized methods used in developing estimates of fracture-network porosity, measurements of evapotranspiration, and characterization of spatial characteristics for some well-construction records are described in the Appendix. The preferred system of units for reporting in this report is the English inch-pound system; however, some data, such as those related to energy measures and rock fractures, are described in metric units as this is a standard and accepted practice.

Historical Data

Much data for the Turkey Creek watershed collected as part of previous studies or maintained by agencies other than the USGS were used in this study. These data provide some descriptions of historical climatologic, streamflow, ground-water level, and water-quality conditions in or around the watershed. The data also include well-construction records available from the Colorado State Engineer’s Office (SEO) and miscellaneous data available from the Jefferson County Planning and Zoning Department including summaries of U.S. Census Bureau information, projections of population growth, locations of occupied households, some historical land-use classifications, and digital orthophoto imagery.

The Colorado Climate Center, in cooperation with the National Weather Service, maintains climatologic records for many locations in Colorado (Colorado Climate Center, 2002). Records for precipitation and daily air temperature extremes from three stations—Bailey (station 50454), Cheesman (station 51528), and Elk Creek (station 52633)—were used as part of this study (fig. 1). In addition, a detailed precipitation record covering more than 40 years (1956–99) was available from John and Marguerite Schoonhoven of Flying J Ranch (RG12 in table 2). Several other intermittent and short-term records of snowfall and temperature were available from various sources.

Historical records include those collected previous to this study and consist of data from two stream gages on Turkey Creek in the vicinity of the present gage (06710992, fig. 4). A summary for time-series data indicating periods of record for stream gages and other data is presented in table 2. Some historical records, from the late 1980’s, of surface-water discharge, or streamflow, in the Turkey Creek watershed are available from the Automatic Data Processing System (ADAPS) part of the National Water Inventory System (NWIS) (Bartholoma, 1997). NWIS is a computer system established by the USGS to manage and provide some analytical capabilities for a wide variety of hydrologic information; ADAPS addresses continuous records of many hydrologic data, including surface-water records. Additional historical records of streamflow from the 1940’s and 1950’s are not included in the NWIS but have been compiled in publications (U.S. Geological Survey, 1942–53).

Table 2. List of sites with time-series records

[Note: primary identifier, U.S. Geological Survey (USGS) station identification number or National Weather Service (NWS) station number; identifier type refers to source for identifier (1 - USGS, 2 - Colorado Climate Center, 3 - State Engineers Office); Local identifier, local identifier used by this study; Location, latitude and longitude in nad27; Elevation, feet above NGVD29; Type, defines type of data collected at site (1 - total daily precipitation [a - tipping bucket, b - weighing bucket], 2 - daily minimum and maximum air temperature, 3 - mean daily discharge, 4 - soil moisture, 5 - solar radiation, 6 - evapotranspiration, 7 - daily mean diversion, 8 - intermittent or monthly depth-to-water measurements, 9 - mean daily depth to water); --, not applicable]

Identifier							
primary	type	local	Location	Elevation	Type	Period of record	Site name
DISCHARGE AND DIVERSIONS							
06710992	1	--	393703 1051324	6420	3	April 13, 2001 - continuing	Turkey Creek near Indian Hills
06710995	1	SWA01	393713 1051141	6040	3	April 1, 1998 - April 13, 2001	Turkey Creek at mouth of Canyon near Morrison
06711040	1	--	393827 1050934	5635	3	June 19, 1942 - September 30, 1953	Turkey Creek above Bear Creek Lake near Morrison
06711000	1	--	393809 1051003	--		April 25, 1986 - September 30, 1989	Turkey Creek near Morrison
393203105221600	1	STR-1	393203 1052216	9100	3	April 10, 2001 - August 1, 2001	North Turkey Creek upper tributary above Aspen Park
393210105205500	1	STR-2	393210 1052055	8435	3	April 10, 2001 - August 1, 2001	North Turkey Creek above Warhawk near Aspen Park
393141105200500	1	STR-3	393141 1052005	8350	3	April 17, 2001 - August 1, 2001	North Turkey Creek tributary above Aspen Park
393443105165800	1	STR-4	393443 1051658	7615	3	April 13, 2001 - August 1, 2001	North Turkey Creek tributary near Gartner Drive near Aspen Park
--	3	head 12	393714 1051155	6115	7	-- - --	Headgate Independent Highline # 12
--	3	head 27	393714 1051141	6015	7	-- - --	Headgate Bergen # 27
CLIMATOLOGIC							
393213105142100	1	RG1	393213 1051421	7460	1a	December 1, 1998 - September 30, 2001	RG1
393145105195900	1	RG2	393145 1051959	8250	1a	no record	RG2
393204105141700	1	RG3	393204 1051417	7900	1a	December 1, 1998 - September 30, 2001	RG3
393404105182701	1	RG4	393404 1051822	7820	1a	December 1, 1998 - September 30, 2001	RG4
393143105135600	1	RG5	393143 1051356	8480	1a	December 1, 1998 - September 30, 2001	RG5
393459105170300	1	RG6	393459 1051703	7560	1a	December 1, 1998 - September 30, 2001	RG6
393552105144201	1	RG7	393552 1051442	7480	1a	December 1, 1998 - September 30, 2001	RG7
393700105114500	1	RG8	393700 1051145	6040	1b,2	August 28, 1998 - September 30, 2001	RG8/AT1
393423105131000	1	RG9	393423 1051310	7160	1b	September 23, 1998 - September 30, 2001	RG9
393249105181900	1	RG10	393248 1051819	8240	1b	February 2, 1999 - September 30, 2001	RG10
393340105201500	1	RG11	393340 1052015	8180	1b	November 25, 1998 - November 23, 2001	RG11
--	1	RG12	393237 1051912	7980	1,2	January 1, 1956 - December 30, 1999	RG12
50454	1	RG13	392421 1052822	7730	11,2	August 1, 1948 - December 31, 1997	Bailey
51520	2	RG14	391313 1051640	6890	11,2	August 1, 1948 - June 30, 2000	Cheesman
52633	2	RG15	392953 1052000	8440	11,2	August 1, 1948 - September 30, 1951	Elk Creek
--	2	RG16	393227 1051925	8180	1a,2,4,5,6	February 3, 1999 - December 31, 2001	RG16/ ET Forest site/ ET Tower
--	2	RG17	393429 1051638	7770	1a,2,4,5,6	June 2, 2000 - December 31, 2001	RG17/ ET Meadow site
--	2	RG18	393429 1051638	7770	1b	December 6, 2000 - September 30, 2001	RG18/ ET Forest site
--	2	AT2	393104 1052109	9760	2	April 1, 2001 - September 30, 2001	Elk Creek Fire Station at Conifer Mountain
--	2	AT3	393304 1051621	8200	2	March 23, 2001 - September 30, 2001	North Meyer Ranch Park
--	2	AT4	393223 1051624	8200	2	March 23, 2001 - September 30, 2001	South Meyer Ranch Park
DEPTH TO WATER							
393821105161001	1	MH1	393820 1051612	7310	8	September 5, 1973 - February 14, 1983	MH1
					9	August 25, 1998 - continuing	
					9	May 23, 2001 - September 30, 2001	
393604105132100	1	MH2	393604 1051321	6900	8	November 4, 1998 - continuing	MH2
393513105181300	1	MH3	393513 1051813	7751	8	July 9, 1998 - continuing	MH3
393459105165701	1	MH4	393459 1051657	7672	8	December 3, 1998 - continuing	MH4
393350105184401	1	MH5	393350 1051844	7900	8	September 5, 1973 - February 14, 1983	MH5
					9	August 25, 1998 - continuing	
					9	May 23, 2001 - September 30, 2001	
393348105171400	1	MH6.1	393348 1051714	8375	8	December 3, 1998 - continuing	MH6.1
393344105171400	1	MH6.2	393344 1051714	8352	8	December 3, 1998 - continuing	MH6.2
393342105171500	1	MH6.3	393342 1051715	8340	8	December 3, 1998 - continuing	MH6.3
39333210515 800	1	MH7	393332 1051508	8337	8	December 3, 1998 - continuing	MH7
393301105150201	1	MH8	393301 1051532	8050	8	September 6, 1973 - February 14, 1983	MH8
					9	July 9, 1998 - continuing	
					9	May 23, 2001 - September 30, 2001	
393121105110600	1	MH9	393121 1051106	6720	8	September 6, 1973 - February 14, 1983	MH9
					9	August 25, 1998 - September 30, 2001	
392958105164601	1	MH10	392958 1051646	7950	8	September 6, 1973 - February 14, 1983	MH10
					9	August 25, 1998 - September 30, 2001	
393112105182100	1	MH11	393112 1051821	8477	8	June 18, 1998 - continuing	MH11
393143105195400	1	MH12	393143 1051954	8187	8	July 10, 1998 - continuing	MH12
393717105145300	1	MH13	393717 1051453	7279	8	May 11, 1999 - continuing	MH13

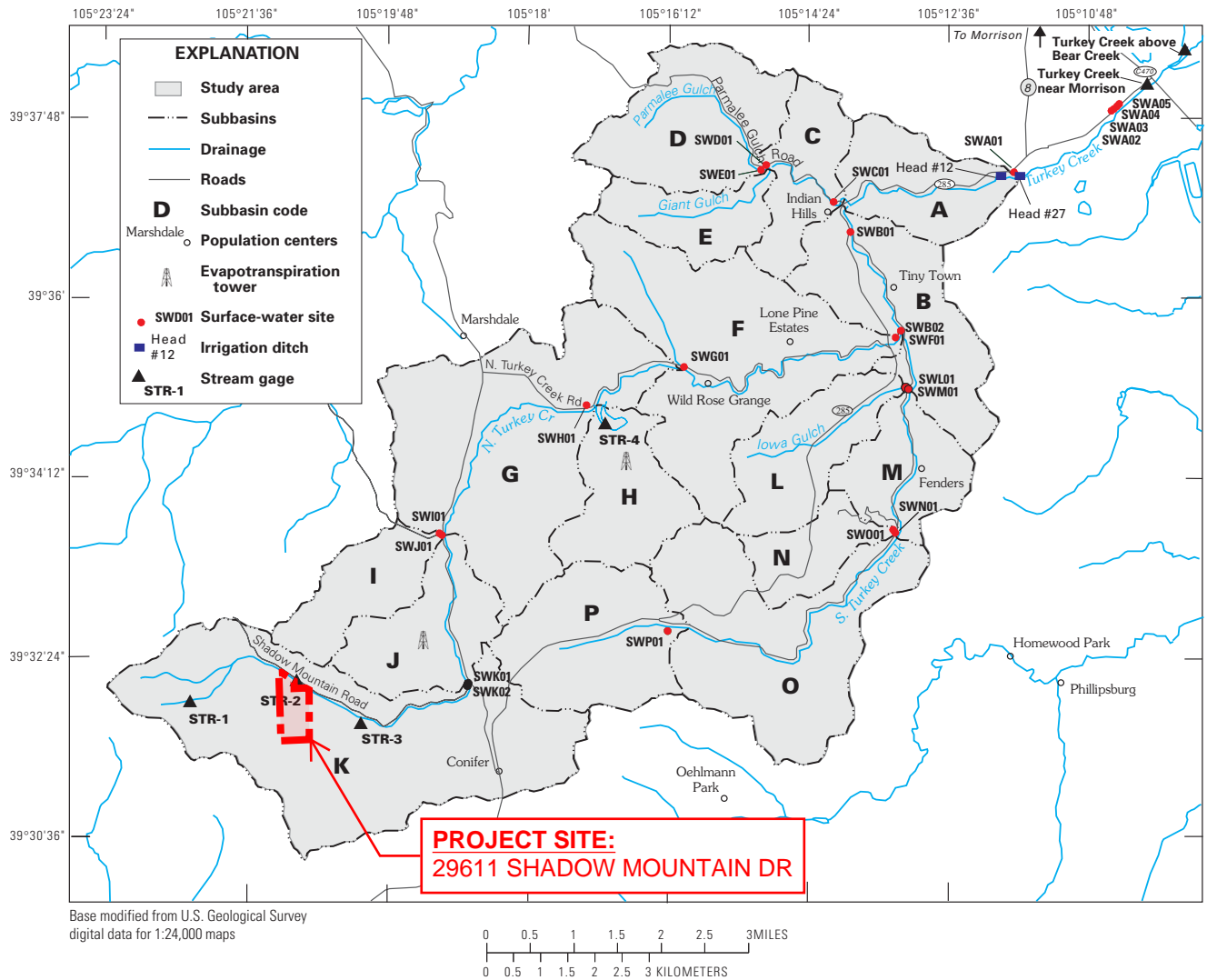


Figure 4. Locations of surface-water streamflow measurement and sampling sites, stream gages, and irrigation ditches.

Two stream gages on Turkey Creek were operated by the USGS at various times previous to this study. Station 06711040, Turkey Creek above Bear Creek Lake near Morrison, about 1.5 mi downstream from the present gage (station 06710992) (fig. 4), has data available from April 25, 1986, through September 30, 1989. Station 06711000, Turkey Creek near Morrison, about 1 mi downstream from the present gage, has data available from June 19, 1942, through September 30, 1953. Diversions from Turkey Creek upstream from these stations complicate streamflow records. Although streamflow records at these stations have an acceptable level of accuracy, they are not representative of stream regulation that occurs upstream from the gages. Regulation activity

typically consists of diversions. The water diverted from streams is not measured at the gages; consequently, the gage record is “low biased,” or consistently less than the sum of measured streamflow and the diversion, during times of diversion. Regulation also may include addition of water to streams. Records for diversions from the Independent Highline and Bergen ditches (fig. 4) are available from the SEO; other records from potential additional diversions or additions are not available.

The SEO is responsible for issuing permits for well construction in Colorado. As part of the permitting process, many well-construction details are obtained by the SEO and retained in their files. Many of these data, such as legal description, drillers’ logs,

and well-completion diagrams, are only available in paper format or scanned images of original paper copies. However, some data are available electronically as digital records. The SEO has about 3,300 digital well records with construction details on file for the Turkey Creek watershed. About 1,100 of those wells, referred to in this report as “permitted wells,” have defined locations that are shown in figure 5. The digital data describe reported well yield, total depth, and depth to water.

Water-quality data from previous studies were available for use in this study. Most of these data were collected in the 1970’s as part of the work by Hofstra and Hall (1975a) and Hall and others (1981). Bruce and McMahon (1997) also collected water-quality data

from a number of wells in Front Range settings, a few of which are in the watershed. In addition, Bruce and McMahon (1997) and Stevens and others (1997) collected water-quality data from wells completed in fractured rocks in other Front Range areas that can be compared to data collected during this study. All of these data include analyses for many water-quality properties and constituents addressed by this study as well as other constituents that are useful to this study. The locations for samples collected during previous studies in the Turkey Creek watershed are shown in figure 6. Univariate statistics for water-quality properties and constituents including major ions and some nutrients collected in previous studies are listed in table 3.

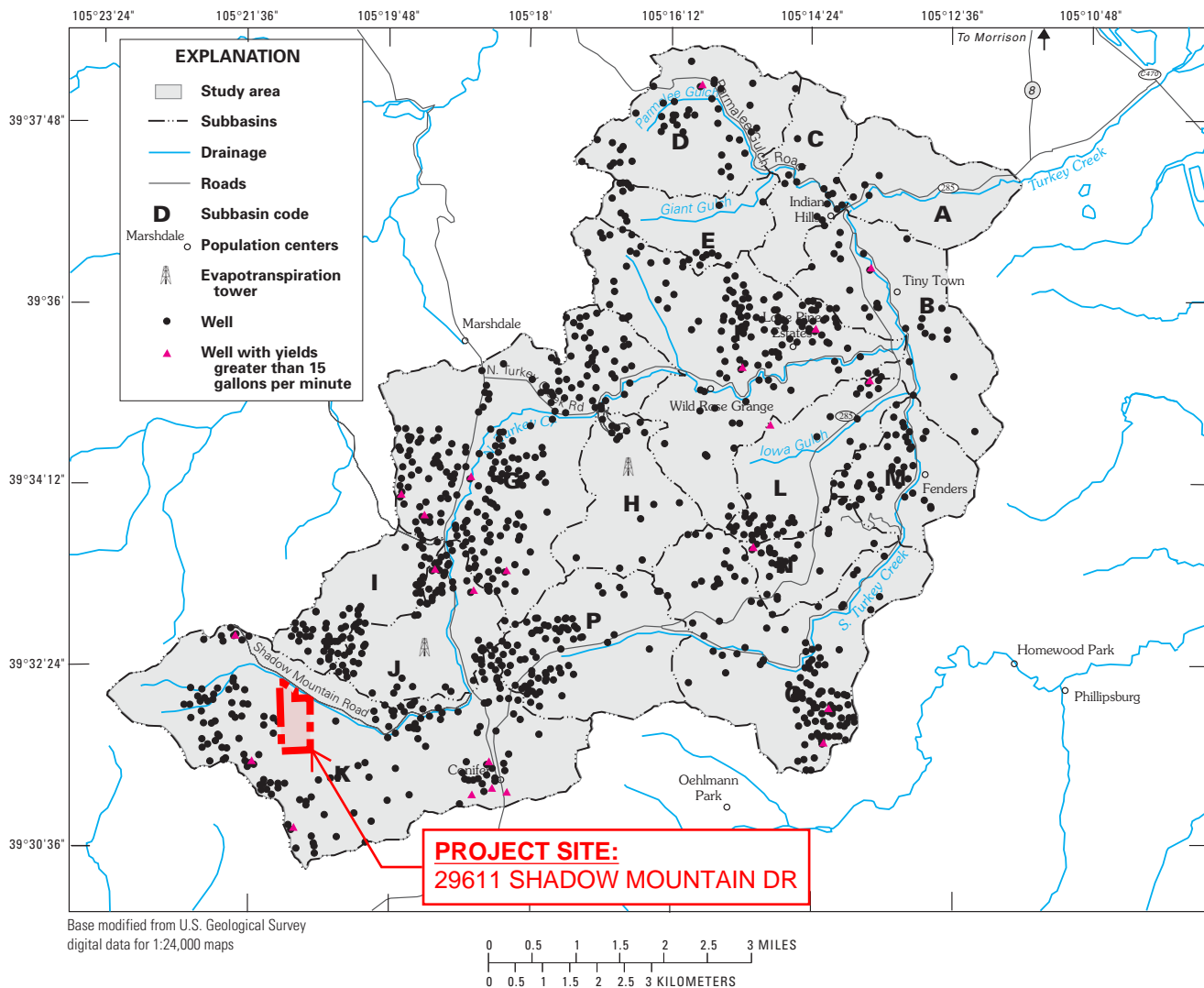


Figure 5. Locations of permitted wells from the State Engineers Office.



United States
Department of
Agriculture

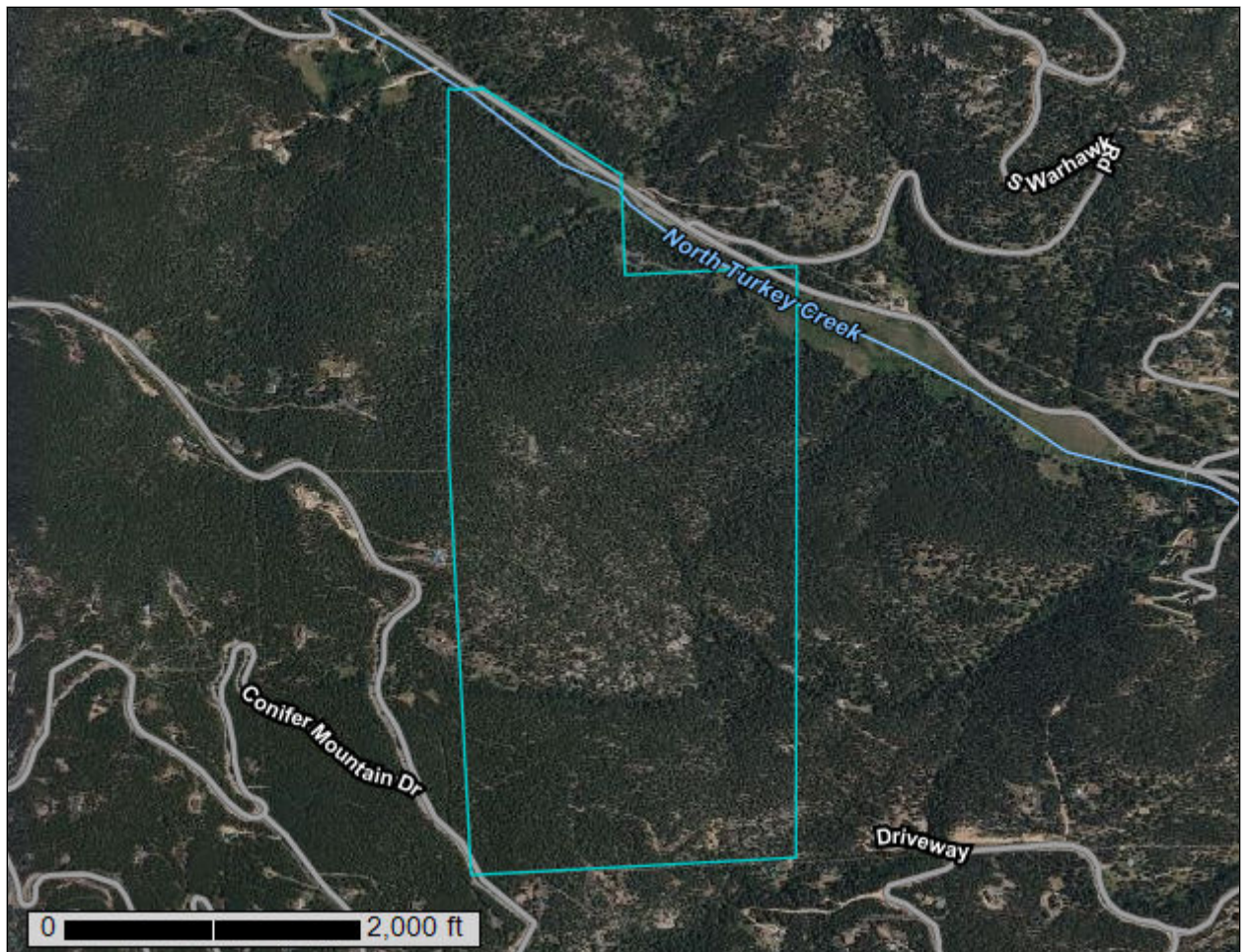
NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties

Shadow Mountain Bike Park



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface	2
How Soil Surveys Are Made	5
Soil Map	8
Soil Map (Shadow Mountain Bike Park).....	9
Legend.....	10
Map Unit Legend (Shadow Mountain Bike Park).....	12
Map Unit Descriptions (Shadow Mountain Bike Park).....	12
Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties.....	14
67—Kittredge-Earcree complex, 9 to 20 percent slopes.....	14
75—Legault-Hiwan stony loamy sands, 5 to 15 percent slopes.....	16
76—Legault-Hiwan stony loamy sands, 15 to 30 percent slopes.....	19
77—Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes.....	21
141—Rogert, very stony-Herbman-Rock outcrop complex, 30 to 70 percent slopes.....	24
References	28

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

Custom Soil Resource Report

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

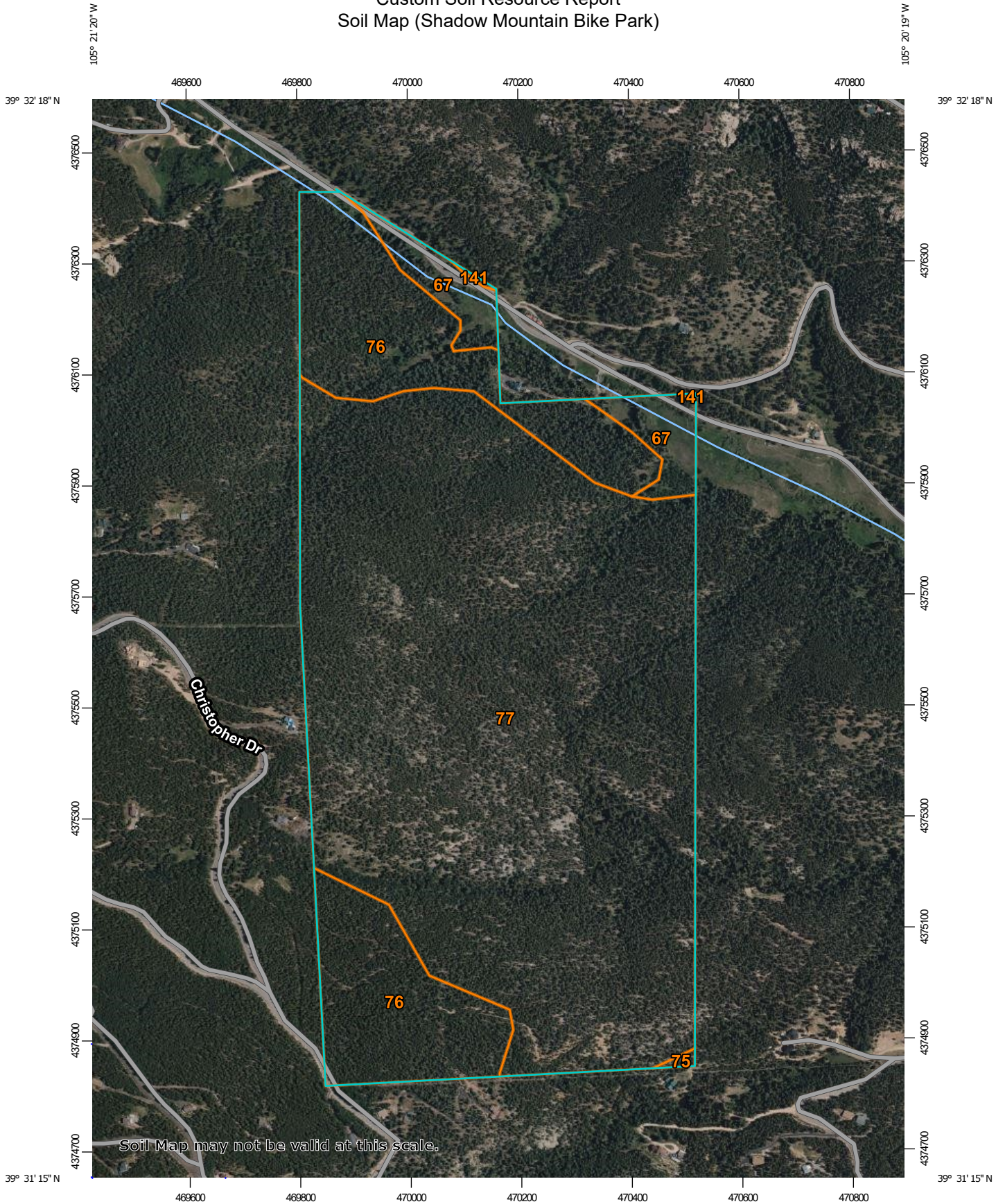
Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

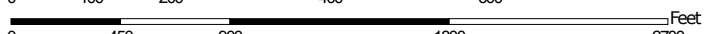
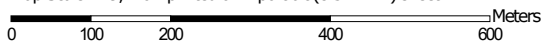
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map (Shadow Mountain Bike Park)



Map Scale: 1:9,470 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties
 Survey Area Data: Version 16, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 1, 2020—Jul 2, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (Shadow Mountain Bike Park)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
67	Kittredge-Earcree complex, 9 to 20 percent slopes	10.1	4.2%
75	Legault-Hiwan stony loamy sands, 5 to 15 percent slopes	0.3	0.1%
76	Legault-Hiwan stony loamy sands, 15 to 30 percent slopes	48.5	20.3%
77	Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes	179.8	75.3%
141	Rogert, very stony-Herbman-Rock outcrop complex, 30 to 70 percent slopes	0.2	0.1%
Totals for Area of Interest		238.9	100.0%

Map Unit Descriptions (Shadow Mountain Bike Park)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

Custom Soil Resource Report

given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Golden Area, Colorado, Parts of Denver, Douglas, Jefferson, and Park Counties

67—Kittredge-Earcree complex, 9 to 20 percent slopes

Map Unit Setting

National map unit symbol: jppt
Elevation: 7,600 to 9,500 feet
Mean annual precipitation: 17 to 20 inches
Mean annual air temperature: 41 to 43 degrees F
Frost-free period: 55 to 75 days
Farmland classification: Not prime farmland

Map Unit Composition

Kittredge and similar soils: 45 percent
Earcree and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kittredge

Setting

Landform: Mountain slopes, terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium and/or colluvium derived from igneous and metamorphic rock

Typical profile

H1 - 0 to 8 inches: sandy loam
H2 - 8 to 29 inches: sandy clay loam
H3 - 29 to 60 inches: sandy loam

Properties and qualities

Slope: 9 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Description of Earcree

Setting

Landform: Alluvial fans

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Noncalcareous, gravelly and loamy alluvium and/or colluvium derived from igneous and metamorphic rock

Typical profile

H1 - 0 to 11 inches: gravelly sandy loam

H2 - 11 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 9 to 20 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: R048AY222CO - Loamy Park

Hydric soil rating: No

Minor Components

Cryofluvents

Percent of map unit: 3 percent

Landform: Flood plains

Down-slope shape: Linear

Across-slope shape: Linear

Ecological site: R048AY010UT - Wet Fresh Streambank (Willow)

Hydric soil rating: No

Urban land

Percent of map unit: 3 percent

Hydric soil rating: No

Rogert

Percent of map unit: 3 percent

Landform: Ridges

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex

Across-slope shape: Convex

Ecological site: F048AY908CO - Mixed Conifer

Hydric soil rating: No

Troutdale

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Venable

Percent of map unit: 3 percent
Landform: Terraces, flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

75—Legault-Hiwan stony loamy sands, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: jpq3
Elevation: 7,600 to 10,000 feet
Mean annual precipitation: 17 to 20 inches
Mean annual air temperature: 41 to 43 degrees F
Frost-free period: 55 to 75 days
Farmland classification: Not prime farmland

Map Unit Composition

Legault and similar soils: 45 percent
Hiwan and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Legault

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Acidic, gravelly, stony, and sandy residuum weathered from igneous and metamorphic rock

Typical profile

H1 - 0 to 2 inches: gravelly loamy sand
H2 - 2 to 14 inches: very gravelly loamy sand
H3 - 14 to 18 inches: weathered bedrock

Custom Soil Resource Report

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Description of Hiwan

Setting

Landform: Mountain slopes, ridges
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Mountainflank, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Acidic, stony, gravelly, and sandy residuum weathered from igneous and metamorphic rock

Typical profile

H1 - 0 to 1 inches: very gravelly loamy sand
H2 - 1 to 15 inches: very gravelly loamy sand
H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Minor Components

Earcree

Percent of map unit: 3 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Grimstone

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Peeler

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F048AY908CO - Mixed Conifer
Other vegetative classification: ABLA-PIEN/VASC (subalpine fir, Engelmann's spruce, grouse whortleberry) (null_6)
Hydric soil rating: No

Rock outcrop

Percent of map unit: 3 percent
Landform: Mountain slopes, ridges
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Free face, mountainflank, side slope, crest, free face
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Herbman

Percent of map unit: 2 percent
Landform: Mountain slopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Urban land

Percent of map unit: 1 percent
Hydric soil rating: No

76—Legault-Hiwan stony loamy sands, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: jpq4
Elevation: 7,600 to 10,000 feet
Mean annual precipitation: 17 to 20 inches
Mean annual air temperature: 41 to 43 degrees F
Frost-free period: 55 to 75 days
Farmland classification: Not prime farmland

Map Unit Composition

Legault and similar soils: 45 percent
Hiwan and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Legault

Setting

Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Convex, linear
Parent material: Acidic, gravelly, stony, and sandy residuum weathered from igneous and metamorphic rock

Typical profile

H1 - 0 to 1 inches: gravelly loamy sand
H2 - 1 to 13 inches: very gravelly loamy sand
H3 - 13 to 17 inches: weathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Description of Hiwan

Setting

Landform: Mountain slopes, ridges

Landform position (two-dimensional): Shoulder, backslope, summit

Landform position (three-dimensional): Mountainflank, crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Acidic, stony, gravelly, and sandy residuum weathered from igneous and metamorphic rock

Typical profile

H1 - 0 to 1 inches: very gravelly loamy sand

H2 - 1 to 15 inches: very gravelly loamy sand

H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 0.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: D

Ecological site: F048AY908CO - Mixed Conifer

Hydric soil rating: No

Minor Components

Grimstone

Percent of map unit: 3 percent

Landform: Mountain slopes

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Mountainflank

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Ecological site: F048AY908CO - Mixed Conifer

Hydric soil rating: No

Rock outcrop

Percent of map unit: 3 percent

Landform: Mountain slopes, ridges

Landform position (two-dimensional): Shoulder, backslope, summit

Landform position (three-dimensional): Mountainflank, free face, side slope, crest, free face

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Hydric soil rating: No

Custom Soil Resource Report

Peeler

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F048AY908CO - Mixed Conifer
Other vegetative classification: ABLA-PIEN/VASC (subalpine fir, Engelmann's spruce, grouse whortleberry) (null_6)
Hydric soil rating: No

Earcree

Percent of map unit: 3 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Herbman

Percent of map unit: 2 percent
Landform: Mountain slopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Urban land

Percent of map unit: 1 percent
Hydric soil rating: No

77—Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: jpq5
Elevation: 7,600 to 10,000 feet
Mean annual precipitation: 17 to 20 inches
Mean annual air temperature: 41 to 43 degrees F
Frost-free period: 55 to 75 days
Farmland classification: Not prime farmland

Map Unit Composition

Legault and similar soils: 35 percent
Hiwan and similar soils: 30 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Legault

Setting

Landform: Ridges, mountain slopes

Landform position (three-dimensional): Mountainflank, crest

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Parent material: Acidic, gravelly, stony, and sandy residuum weathered from igneous and metamorphic rock

Typical profile

H1 - 0 to 1 inches: gravelly loamy sand

H2 - 1 to 13 inches: very gravelly loamy sand

H3 - 13 to 17 inches: weathered bedrock

Properties and qualities

Slope: 30 to 50 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 0.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: D

Ecological site: F048AY908CO - Mixed Conifer

Hydric soil rating: No

Description of Hiwan

Setting

Landform: Mountain slopes, ridges

Landform position (two-dimensional): Shoulder, backslope, summit

Landform position (three-dimensional): Mountainflank, crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Acidic, stony, gravelly, and sandy residuum weathered from igneous and metamorphic rock

Typical profile

H1 - 0 to 1 inches: very gravelly loamy sand

H2 - 1 to 15 inches: very gravelly loamy sand

H3 - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 50 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Custom Soil Resource Report

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 0.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Mountain slopes, ridges
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Mountainflank, free face, side slope, crest, free face
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Igneous and metamorphic rock

Typical profile

H1 - 0 to 60 inches: unweathered bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Grimstone

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Herbman

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Mountaintop, mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Rogert

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Shoulder, backslope

Custom Soil Resource Report

Landform position (three-dimensional): Upper third of mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

Peeler

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: F048AY908CO - Mixed Conifer
Other vegetative classification: ABLA-PIEN/VASC (subalpine fir, Engelmann's spruce, grouse whortleberry) (null_6)
Hydric soil rating: No

Tolvar

Percent of map unit: 3 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F048AY908CO - Mixed Conifer
Hydric soil rating: No

141—Rogert, very stony-Herbman-Rock outcrop complex, 30 to 70 percent slopes

Map Unit Setting

National map unit symbol: 2tz4y
Elevation: 7,590 to 10,000 feet
Mean annual precipitation: 17 to 23 inches
Mean annual air temperature: 37 to 43 degrees F
Frost-free period: 25 to 75 days
Farmland classification: Not prime farmland

Map Unit Composition

Rogert, very stony, and similar soils: 45 percent
Herbman and similar soils: 30 percent
Rock outcrop: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rogert, Very Stony

Setting

Landform: Ridges, mountain slopes

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Mountaintop, upper third of mountainflank

Down-slope shape: Linear, convex

Across-slope shape: Linear, convex

Parent material: Colluvium over residuum weathered from igneous and metamorphic rock

Typical profile

A - 0 to 8 inches: very cobbly sandy loam

C - 8 to 16 inches: very gravelly sandy loam

R - 16 to 79 inches: bedrock

Properties and qualities

Slope: 30 to 70 percent

Surface area covered with cobbles, stones or boulders: 2.0 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.57 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): 7e

Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: D

Ecological site: R048AY237CO - Stony Loam

Hydric soil rating: No

Description of Herberman

Setting

Landform: Mountain slopes, ridges

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Mountaintop, mountainflank, crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Colluvium over residuum weathered from igneous and metamorphic rock

Typical profile

A - 0 to 4 inches: very gravelly sandy loam

AC - 4 to 14 inches: very gravelly sandy loam

Cr - 14 to 79 inches: bedrock

Properties and qualities

Slope: 30 to 70 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.00 to 0.28 in/hr)

Custom Soil Resource Report

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 7e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R048AY237CO - Stony Loam
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Mountain slopes, ridges
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Mountainflank, free face, side slope, crest, free face
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Rock outcrops, talus, and large boulders of igneous and metamorphic rock

Interpretive groups

Land capability classification (irrigated): 8
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Troutdale

Percent of map unit: 3 percent
Landform: Ridges, mountain slopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Mountainflank, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R048AY228CO - Mountain Loam
Hydric soil rating: No

Kittredge

Percent of map unit: 3 percent
Landform: Alluvial fans, mountain slopes
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R048AY228CO - Mountain Loam
Hydric soil rating: No

Sprucedale

Percent of map unit: 2 percent
Landform: Ridges, mountain slopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Mountaintop, mountainflank, side slope, crest

Custom Soil Resource Report

Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R048AY228CO - Mountain Loam
Hydric soil rating: No

Pettingell

Percent of map unit: 2 percent
Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Ecological site: R048AY237CO - Stony Loam
Hydric soil rating: No

References

- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Calculation of Peak Runoff using Rational Method

Designer: Olivia Dawson, P.E.
 Company: SE Group
 Date: 11/2/2022
 Project: Shadow Mountain Bike Park
 Location: 29611 Shadow Mnt Dr Conifer, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
 Cells of this color are for optional override values
 Cells of this color are for calculated results based on overrides

$$t_t = \frac{0.395(1.1 - C_s)\sqrt{L_t}}{S_t^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_t + t_r$

$t_{\text{minimum}} = 5$ (urban)
 $t_{\text{minimum}} = 10$ (non-urban)

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Selected $t_c = \max\{t_{\text{minimum}}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

1-hour rainfall depth, P1 (in)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
	0.85	1.19	1.39		1.93	2.20	

Rainfall Intensity Equation Coefficients = $\frac{a}{b + t_c^c}$

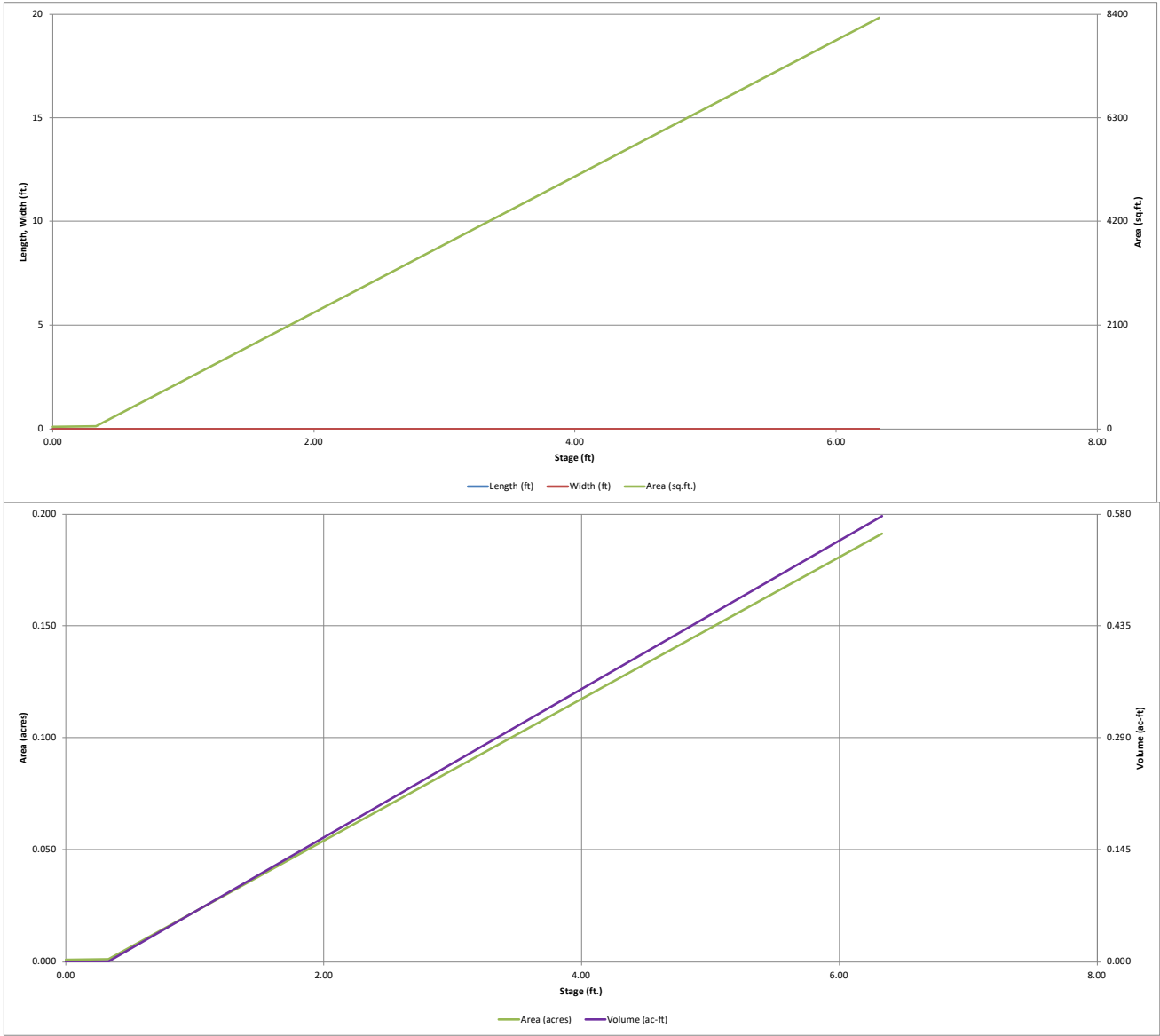
a	b	c
28.50	10.00	0.786

$Q(\text{cfs}) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time					Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)							
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S _t (ft/ft)	Overland Flow Time t _t (min)	Channelized Flow Length L _t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V _t (ft/sec)	Channelized Flow Time t _t (min)	Computed t _c (min)	Regional t _c (min)	Selected t _c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
H1	2.74	D	2.00	0.01	0.05	0.15	0.33	0.40	0.49	0.59	230.00	8432.97	8390.54	0.184	10.97	5.00			0.010	5	0.50	0.17	11.14	25.75	11.14	2.20	3.08	3.60		5.00	5.70		0.06	0.43	1.45		5.52	7.68
H2	4.01	B	2.00	0.01	0.01	0.07	0.26	0.34	0.44	0.54	500.00	8405.21	8371.58	0.067	23.41	5.00			0.010	2.5	0.25	0.33	23.75	25.75	23.75	1.52	2.13	2.49		3.46	3.95		0.05	0.10	0.73		4.71	6.89
D1	2.74	D	43.0	0.32	0.39	0.45	0.56	0.61	0.66	0.72	300.00	8432.97	8389.33	0.145	9.24	5.00			0.010	10	1.00	0.08	9.32	18.75	9.32	2.36	3.31	3.86		5.37	6.12		2.09	3.49	4.74		8.90	11.06
D2	3.61	B	31.0	0.21	0.24	0.31	0.44	0.50	0.57	0.65	200.00	8379.40	8368.23	0.056	12.45	185.00	8389.33	8379.40	0.054	20	4.63	0.67	13.12	21.73	13.12	2.05	2.87	3.36		4.66	5.31		1.57	2.49	3.72		8.43	10.93
OS	0.40	B	2.0	0.01	0.01	0.07	0.26	0.34	0.44	0.54	200.00	8378.00	8369.00	0.045	16.91	5.00			0.010	2.5	0.25	0.33	17.24	25.75	17.24	1.80	2.53	2.95		4.10	4.67		0.01	0.01	0.09		0.56	0.81

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

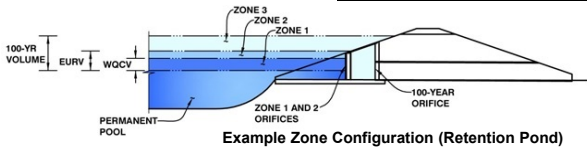
MHFD-Detention, Version 4.06 (July 2022)



DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Shadow Mountain Bike Park
Basin ID: Developed Drainage Plan Basin



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.75	0.095	Orifice Plate
Zone 2 (EURV)	4.32	0.161	Circular Orifice
Zone 3 (100-year)	5.56	0.184	Weir&Pipe (Restrict)
Total (all zones)		0.440	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
 Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
 Orifice Plate: Orifice Vertical Spacing = inches
 Orifice Plate: Orifice Area per Row = sq. inches (diameter = 11/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.92	1.83					
Orifice Area (sq. inches)	0.37	0.37	0.37					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	4.32	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	2.17	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.03	N/A	ft ²
Vertical Orifice Centroid =	0.09	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.32	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Gate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Gate Type =	Close Mesh Gate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Gate Upper Edge, H ₁ =	5.32	N/A	feet
Overflow Weir Slope Length =	4.12	N/A	feet
Gate Open Area / 100-yr Orifice Area =	16.33	N/A	
Overflow Gate Open Area w/o Debris =	9.78	N/A	ft ²
Overflow Gate Open Area w/ Debris =	4.89	N/A	ft ²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	6.70		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.60	N/A	ft ²
Outlet Orifice Centroid =	0.33	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.31	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	5.40	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.60	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.29	feet
Stage at Top of Freeboard =	6.29	feet
Basin Area at Top of Freeboard =	0.19	acres
Basin Volume at Top of Freeboard =	0.57	acre-ft

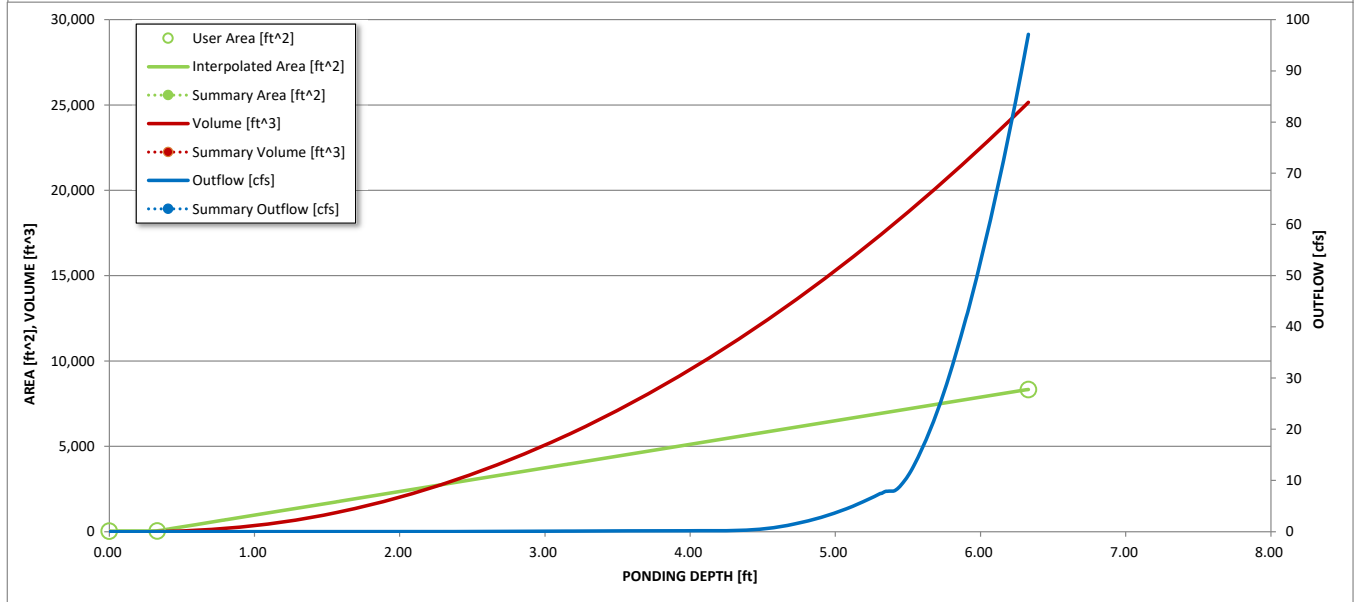
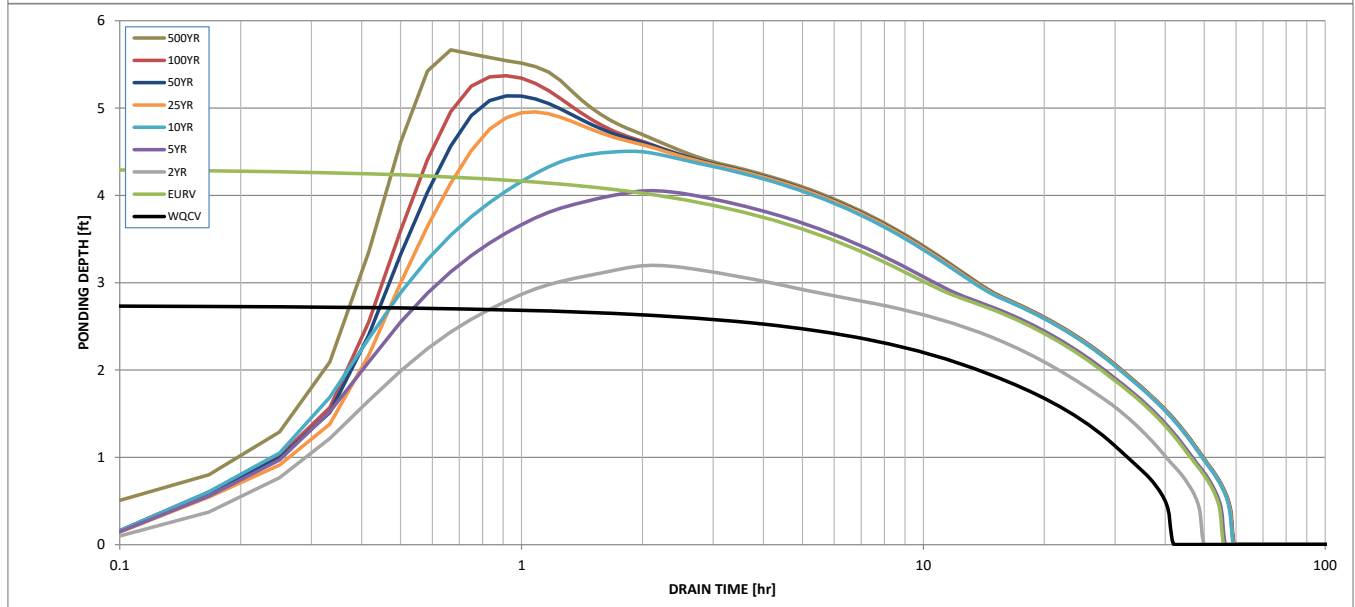
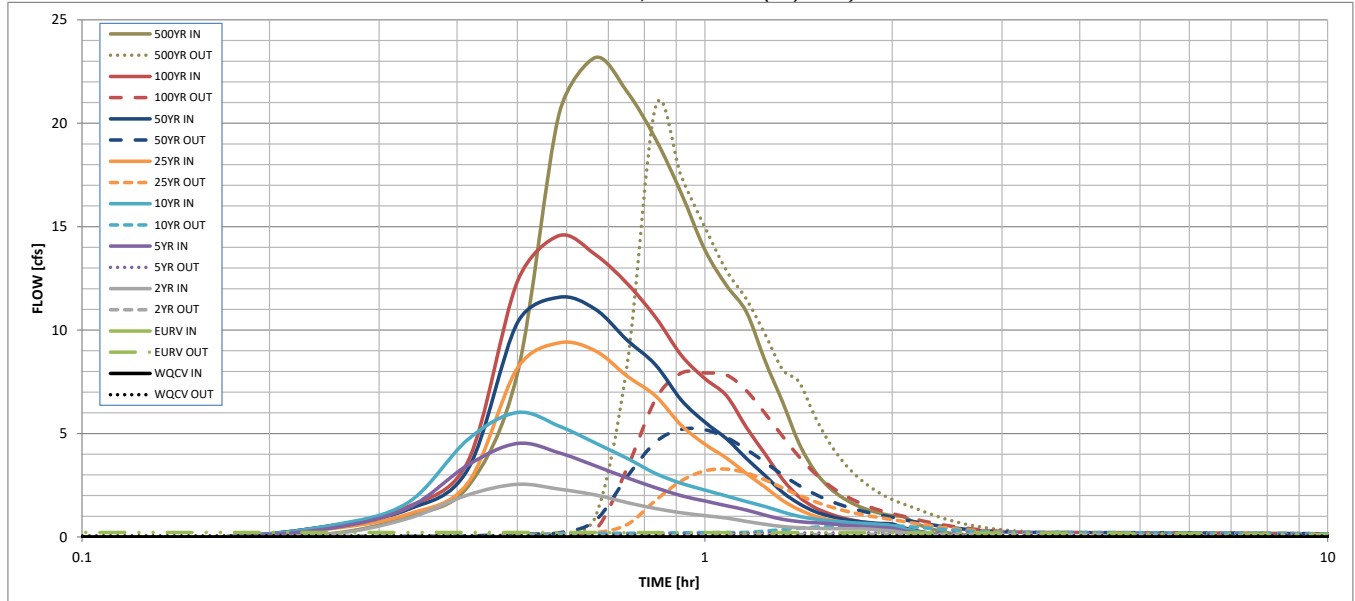
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

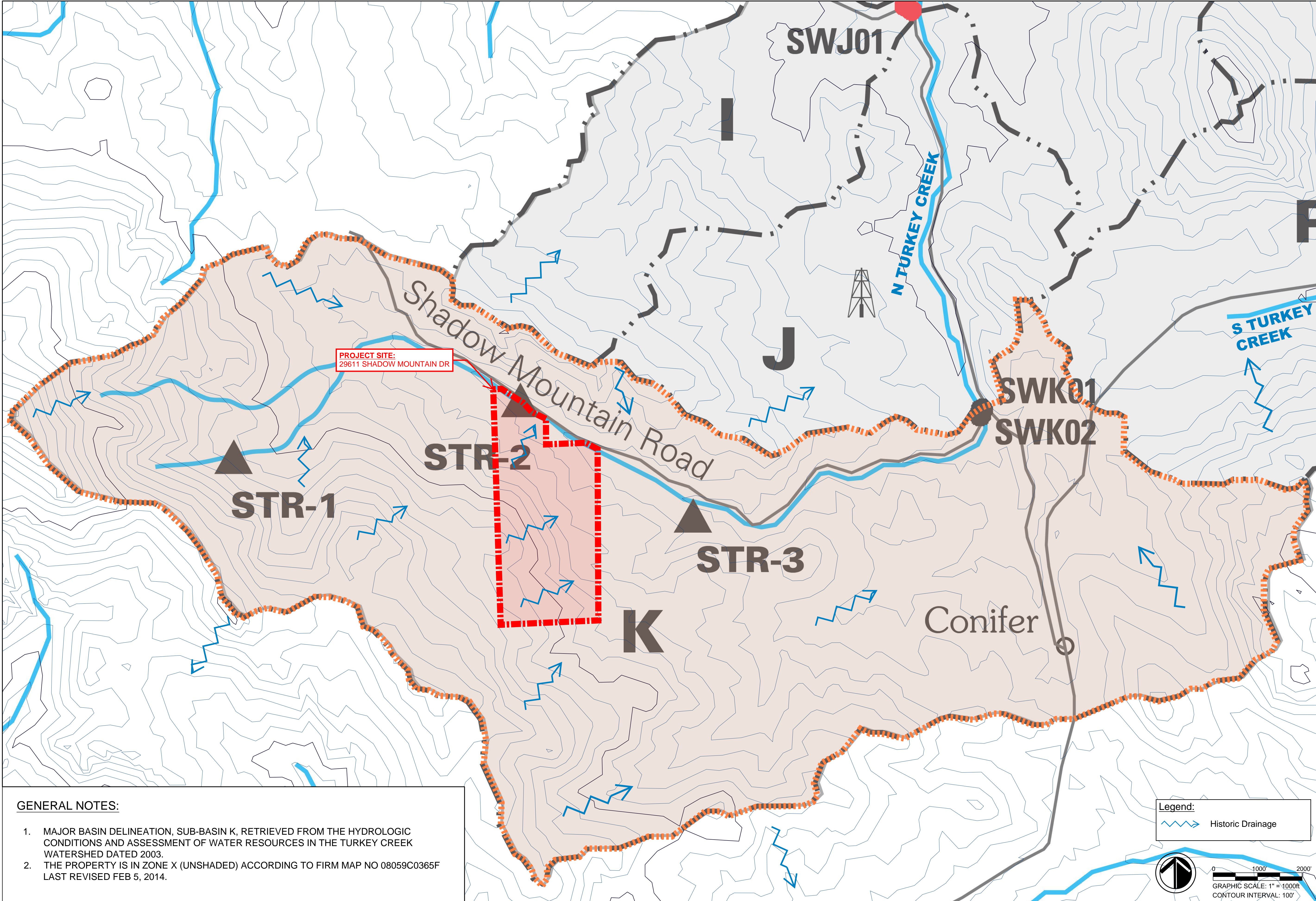
	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	0.85	1.19	1.39	1.69	1.93	2.20	3.14
One-Hour Rainfall Depth (in) =	N/A	N/A	0.256	0.149	0.251	0.330	0.507	0.624	1.271
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.149	0.251	0.330	0.507	0.624	0.785	1.271
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.1	0.9	1.9	4.9	6.5	8.5	14.8
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.01	0.14	0.30	0.77	1.02	1.35	2.34
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	2.5	4.5	6.0	9.4	11.6	14.6	23.2
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.1	0.2	0.6	3.3	5.2	7.9	20.8
Peak Inflow Q (cfs) =	N/A	N/A	N/A	0.2	0.3	0.7	0.8	0.9	1.4
Peak Outflow Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.5	0.8	0.8
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	47	44	47	48	45	43	41	34
Time to Drain 99% of Inflow Volume (hours) =	40	52	47	53	54	53	51	50	47
Maximum Ponding Depth (ft) =	2.74	4.32	3.20	4.05	4.50	4.96	5.14	5.37	5.67
Area at Maximum Ponding Depth (acres) =	0.08	0.13	0.09	0.12	0.13	0.15	0.15	0.16	0.17
Maximum Volume Stored (acre-ft) =	0.095	0.257	0.133	0.224	0.281	0.344	0.371	0.407	0.457

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



**SHADOW MOUNTAIN
 BIKE PARK**
 CONIFER, COLORADO

Not For Construction

ISSUE
 SCHEMATIC
 DESIGN

RELEASE DATE
 November 22

REVISIONS

PROJECT NO. 22089001
MADE BY OD
REVIEWED BY OD

**GENERAL
 LOCATION MAP**

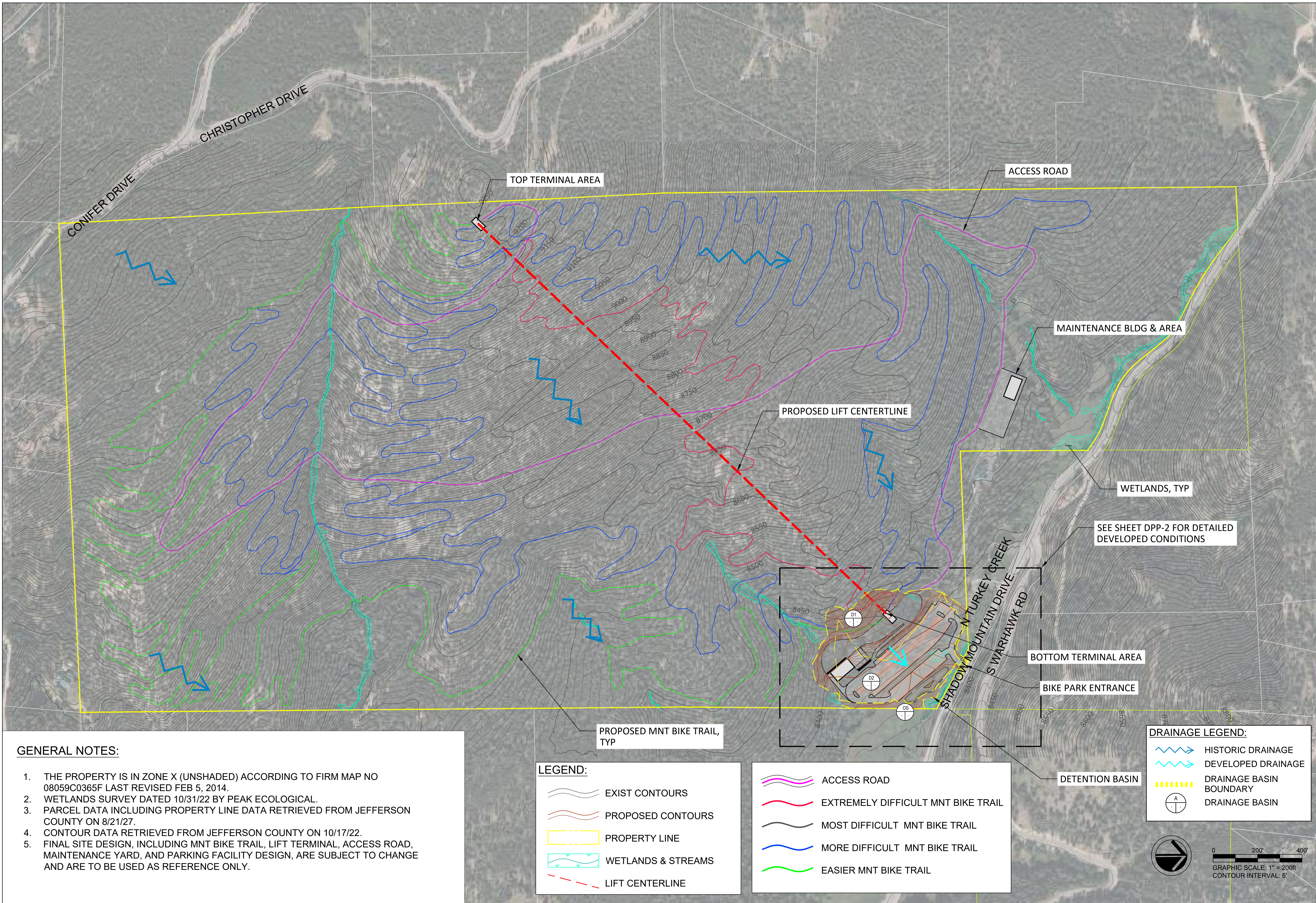
DPE

GENERAL NOTES:

1. MAJOR BASIN DELINEATION, SUB-BASIN K, RETRIEVED FROM THE HYDROLOGIC CONDITIONS AND ASSESSMENT OF WATER RESOURCES IN THE TURKEY CREEK WATERSHED DATED 2003.
2. THE PROPERTY IS IN ZONE X (UNSHADED) ACCORDING TO FIRM MAP NO 08059C0365F LAST REVISED FEB 5, 2014.

Legend:
 Historic Drainage

GRAPHIC SCALE: 1" = 1000ft
 CONTOUR INTERVAL: 100'



GENERAL NOTES:

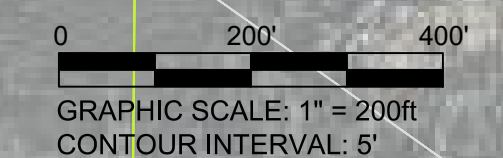
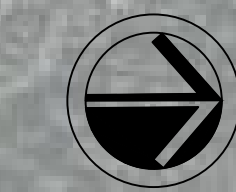
1. THE PROPERTY IS IN ZONE X (UNSHADED) ACCORDING TO FIRM MAP NO 08059C0365F LAST REVISED FEB 5, 2014.
2. WETLANDS SURVEY DATED 10/31/22 BY PEAK ECOLOGICAL.
3. PARCEL DATA INCLUDING PROPERTY LINE DATA RETRIEVED FROM JEFFERSON COUNTY ON 8/21/27.
4. CONTOUR DATA RETRIEVED FROM JEFFERSON COUNTY ON 10/17/22.
5. FINAL SITE DESIGN, INCLUDING MNT BIKE TRAIL, LIFT TERMINAL, ACCESS ROAD, MAINTENANCE YARD, AND PARKING FACILITY DESIGN, ARE SUBJECT TO CHANGE AND ARE TO BE USED AS REFERENCE ONLY.

LEGEND:

- | | | | |
|--|--------------------|--|------------------------------------|
| | EXIST CONTOURS | | ACCESS ROAD |
| | PROPOSED CONTOURS | | EXTREMELY DIFFICULT MNT BIKE TRAIL |
| | PROPERTY LINE | | MOST DIFFICULT MNT BIKE TRAIL |
| | WETLANDS & STREAMS | | MORE DIFFICULT MNT BIKE TRAIL |
| | LIFT CENTERLINE | | EASIER MNT BIKE TRAIL |

DRAINAGE LEGEND:

- | | |
|--|-------------------------|
| | HISTORIC DRAINAGE |
| | DEVELOPED DRAINAGE |
| | DRAINAGE BASIN BOUNDARY |
| | DRAINAGE BASIN |



**SHADOW MOUNTAIN
BIKE PARK**
CONIFER, COLORADO

Not For Construction

ISSUE

SCHEMATIC
DESIGN

RELEASE DATE

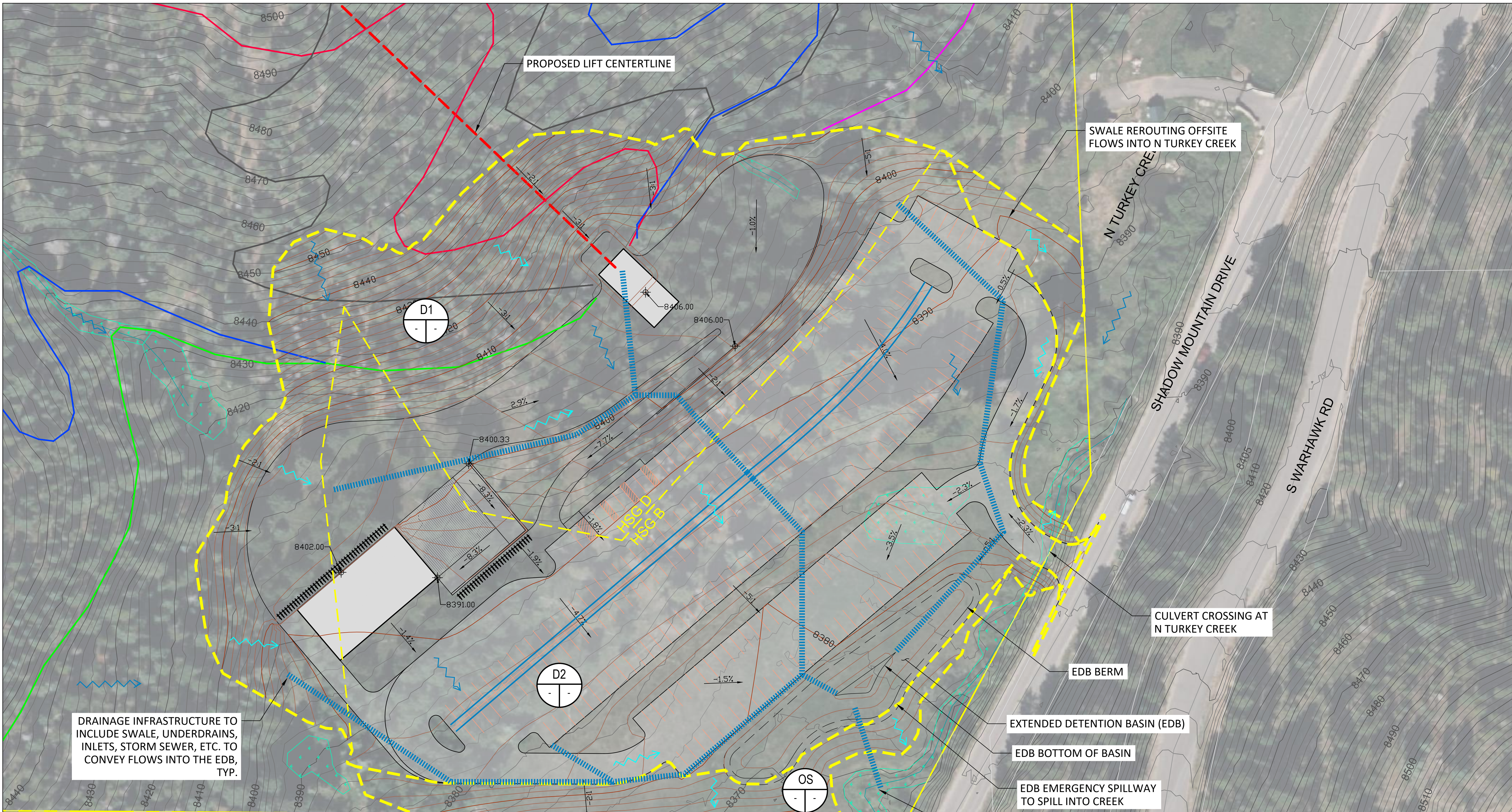
November 22

REVISIONS

PROJECT NO.	22089001
MADE BY	OD
REVIEWED BY	OD

**DEVELOPED
DRAINAGE
CONDITIONS**

DPP-1



**SHADOW MOUNTAIN
 BIKE PARK**
 CONFIER, COLORADO

Not For Construction

ISSUE
 SCHEMATIC
 DESIGN

RELEASE DATE
 November 22

REVISIONS

PROJECT NO. 22089001
 MADE BY OD
 REVIEWED BY OD

**DEVELOPED
 DRAINAGE
 CONDITIONS**

GENERAL NOTES:

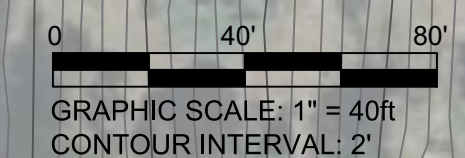
1. THE PROPERTY IS IN ZONE X (UNSHADED) ACCORDING TO FIRM MAP NO 08059C0365F LAST REVISED FEB 5, 2014.
2. WETLANDS SURVEY DATED 10/31/22 BY PEAK ECOLOGICAL.
3. PARCEL DATA INCLUDING PROPERTY LINE DATA RETRIEVED FROM JEFFERSON COUNTY ON 8/21/27.
4. CONTOUR DATA RETRIEVED FROM JEFFERSON COUNTY ON 10/17/22.
5. FINAL SITE DESIGN, INCLUDING MNT BIKE TRAIL, LIFT TERMINAL, ACCESS ROAD, MAINTENANCE YARD, AND PARKING FACILITY DESIGN, ARE SUBJECT TO CHANGE AND ARE TO BE USED AS REFERENCE ONLY.

LEGEND:

- | | |
|--------------------|------------------------------------|
| EXIST CONTOURS | ACCESS ROAD |
| PROPOSED CONTOURS | EXTREMELY DIFFICULT MNT BIKE TRAIL |
| PROPERTY LINE | MOST DIFFICULT MNT BIKE TRAIL |
| WETLANDS & STREAMS | MORE DIFFICULT MNT BIKE TRAIL |
| LIFT CENTERLINE | EASIER MNT BIKE TRAIL |

DRAINAGE LEGEND:

- | | |
|--|----------------------------------|
| | HISTORIC DRAINAGE |
| | DEVELOPED DRAINAGE |
| | PROPOSED DRAINAGE INFRASTRUCTURE |
| | DRAINAGE BASIN BOUNDARY |
| | DRAINAGE BASIN |



**ENGINEERING STUDY
for
SHADOW MOUNTAIN BIKE PARK
CONCEPT MASTER PLAN
WASTEWATER SYSTEM IMPROVEMENTS**

Prepared For:

**Colorado State Land Board
Shadow Mountain Bike Park
SE Group
Frisco, Colorado
PO Box 2729
323 West Main Street, Suite 202
Frisco, CO 80443-2729**

Prepared By:

Stantec
5725 Mark Dabling Blvd. Suite 190
Colorado Springs CO 80919

**November 2022
Revised April 2024
Project No. 181711248**

***** CONTENTS *****

Section 1	EXECUTIVE SUMMARY	1
Section 2	INTRODUCTION	2
2.1	Purpose	2
2.2	Scope	2
Section 3	EXISTING CONDITIONS	3
3.1	Description of Service Area	3
3.2	Land Use	3
3.3	Topography and Floodplains	3
3.4	Geology	3
3.5	Groundwater	3
3.6	Climate	6
3.7	Natural Hazards Analysis	6
3.8	Organizational Context	6
3.9	Wastewater Facilities	6
3.10	Relationship to Neighboring Water and Wastewater Facility	7
Section 4	DEVELOPED CONDITIONS	9
4.1	Land Use	9
4.2	Population and Employment	10
4.3	Wastewater Demand	10
4.4	Wastewater Supply	12
4.5	Wastewater Quality	12
Section 5	WASTEWATER SYSTEM IMPROVEMENTS	13
5.1	General	13
5.2	Wastewater Treatment	13
5.3	Collection	13
5.4	Estimated Costs	13
5.5	Rates and Charges	13

******* APPENDICES *******

Appendix A	100-Year Flood Plain Certification
Appendix B	Wastewater Improvements
Appendix C	Form 6001

******* LIST OF FIGURES *******

Figure 1	Vicinity Map
----------	--------------

Section 1 EXECUTIVE SUMMARY

This report presents the results of the engineering study for wastewater system improvements serving Shadow Mountain Bike Park proposed on State Land Board Shadow Mountain parcels in Jefferson County, Colorado. Shadow Mountain Bike Park is proposed on undeveloped property with a designated address of 29611 Shadow Mountain Drive, Conifer, Colorado 80433.

The proposed parcel currently has no wastewater facilities on site. Shadow Mountain Bike Park proposes construction of a On-site Wastewater Treatment System (OWTS) to provide wastewater treatment per Jefferson County requirements. The facility is anticipated to be a Septic System with a capacity of less than 4400 gpd.

Shadow Mountain Bike Park facilities will consist of a Base Lodge operating as a Class III Recreation facility to welcome guests and provide basic needs such as welcoming center including drinking water and restrooms as well as a maintenance facility for storage and employee use, including water and additional restroom.

The average annual water demand for Shadow Mountain Bike Park is estimated to be 4.72 acre-feet of water per year. Average day usage is estimated to be 5400 gpd or 3.75 gpm. This water will be provided by water wells as permitted by the Colorado State Engineers Office.

Wastewater is estimated to be 80% of water demand. The Shadow Mountain Bike Park wastewater treatment requirements is estimated to be 4320 gpd (5400 x 0.8). An OWTS constructed per Jefferson County requirements will be constructed to treat the wastewater prior to discharge through an anticipated leach field.

Section 2 INTRODUCTION

2.1 Purpose

The purpose of this report is to present wastewater system improvements recommended to serve Shadow Mountain Bike Park; a proposed recreational development project located in Jefferson County. It is also intended to serve as a guideline for the ensuing design of recommended improvements.

2.2 Scope

The scope of this report includes:

1. The definition of the service areas as well as identification of significant physical and environmental characteristics and constraints;
2. An analysis of available data to determine existing and to project future wastewater demands and treatment;
3. A description of legal, institutional and managerial arrangements that ensure adequate control of the proposed improvements; and,
4. A preliminary recommendation for a selected collection, treatment and potential pumping and transmission alternatives.

Section 3 EXISTING CONDITIONS

3.1 Description of the Service Area

Shadow Mountain Bike Park consists of approximately 235 acres of Base Lodge (10 acres +/-) and open space uses and is located northwest of the Conifer Colorado, within Township 6 South, Range 71 West, Section 16.

3.2 Land Use

Shadow Mountain Bike Park is in Jefferson County northwest of Conifer, Colorado and about 35 miles southwest of the Denver Metroplex. Surrounding areas are primarily large tract residential properties and large undeveloped tracts.

3.3 Topography and Floodplains

The topography of the service area is typical of a Colorado Front Range Mountain parcel with elevations ranging from 8400 ft. to 9250 ft. above sea level. Existing slopes range from 5% at base camp to 25% or greater in some areas. Vegetation is typical Colorado mountain woodlands with a mix of Ponderosa Pine, Spruce, Fir and ground cover plants and grasses. The area drains generally northeast to North Turkey Creek.

There is no Federal Emergency Management Agency (FEMA 08059CO365F) established floodplain within the boundaries of Shadow Mountain Bike Park. See Appendix A.

3.4 Geology

The site is comprised of several different soil types. From the NRCS Soil Survey of Jefferson County, the site falls into the following soil types:

1. "67" Kittredge-Earcree, 9 to 20 percent slopes; Type A Soil
 2. "76" Legault-Hiwan stony loamy sands, 15 to 30 percent slopes; Type D Soil
 3. "77" Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes; Type D Soil
 4. "138" Rock outcrop, igneous and metamorphic; Type D Soil
 5. "141" Rogert, very stony-Herbman-Rock outcrop complex, 30 to 70 percent slopes; Type D Soil
- Note: "#" indicates Soil Conservation Survey soil classification number.

3.5 Groundwater

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. The applicant has been in discussion with the State Engineers Office concerning a well permit for the site including the type of permit and the uses permitted to ensure proper permitting. There are numerous wells in the area and discussions with the State indicate issuance of a permit could be made based on water rights associated with the property without injury to adjacent water rights.

Any water well constructed on site would be constructed at an elevation and distance from the OWTS as required by Jefferson County and the State Engineers Office.

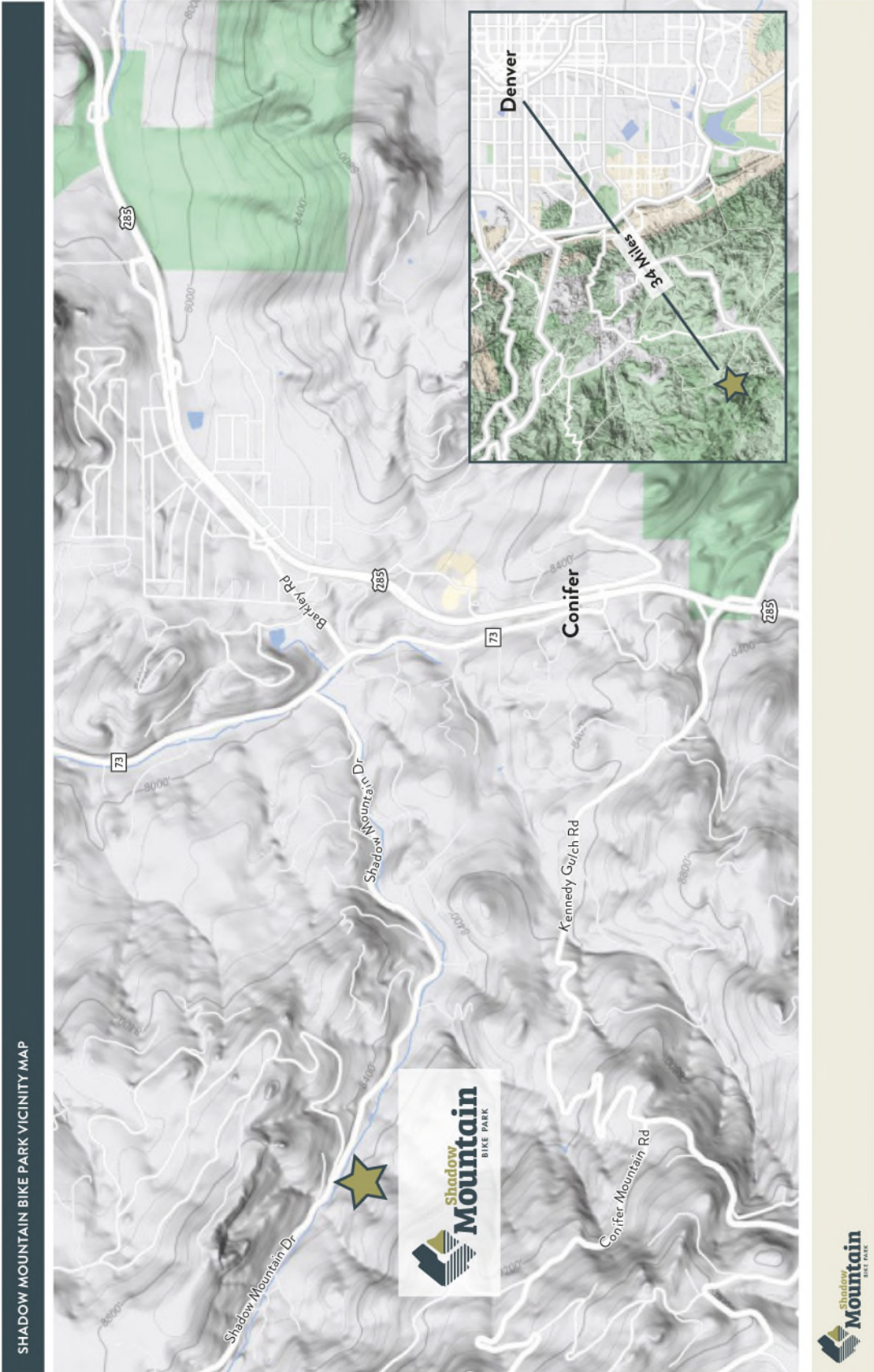


Figure 1: Vicinity Map

3.6 Climate

The climate of the study area is characterized by mild summers and moderately severe winters, moderate precipitation, high evaporation, and moderately high wind velocities.

The average annual monthly temperature is 43.5 F with an average monthly low of 10.3 F in the winter and an average monthly high of 76.1 F in the summer.

Precipitation averages 17.3 inches annually, with 50% of this falling as snow. August is the wettest month and January is the driest. The average annual Class A pan evaporation is 45 inches.

3.7 Natural Hazards Analysis

Natural hazards analysis indicates that no unusual surface or subsurface hazards are located in the service area. However, because the soils are cohesionless, sloughing of steep banks during drilling and/or excavation could occur. By siting improvements in a manner that provides an opportunity to lay the banks of excavations back at a 1:1 slope during construction, the problems associated with sloughing soils can be minimized.

3.8 Organizational Context

Shadow Mountain Bike Park is situated within the North Turkey Creek basin of Jefferson County. The closest public wastewater service would be from the Mountain Water and Sanitation District near Conifer, Colorado. The distance and topography to Conifer in general is cost prohibitive in terms of a wastewater servicer for the bike park.

The amount of wastewater produced at the facility and the distance to other providers makes an onsite OWTS the best for meeting on-site demands. The Mountain Shadow Bike Park will be the entity responsible to finance, construct and ensure the continuing operation and maintenance of improvements.

3.9 Wastewater Facilities

The proposed OWTS is anticipated to consist of a septic tank and leach field designed to treat in excess of 4320 gpd. Design and construction of the OWTS will be in accordance with Jefferson County OWTS requirements including site application and design approval (§25-8-702, C.R.S.) and the discharge permit requirements in the Water Quality Control Act (§25-8-501, et seq. C.R.S.).

3.10 Relationship to Neighboring Water and Wastewater Facilities

The Town of Conifer is the closest potential provider of water and wastewater facilities. The distance and topography between the site and the town make any connection cost prohibitive.

Section 4 DEVELOPED CONDITIONS

4.1 Land Use

Shadow Mountain Bike Park consists of approximately 235 acres of State Land Board undeveloped property. Most of the site will be left undeveloped except for the addition of Bike Trails, a bike lift and development of approximately 10 acres for a base lodge including one building for welcoming, ticketing, water facilities and restrooms and one additional building for maintenance and employees with an additional restroom.

Assumptions: Employees water usage is estimated to be 20 gallons per day (gpd)
Guest Water Usage is estimated to be 4 gpd
Irrigation will be minimal or not at all with xeriscape or extensions of the natural surroundings.

4.2 Population and Employment

The applicant estimates that there will be up to 30 onsite employees in a given day. The maximum day guest population is estimated to be 1200.

4.3 Wastewater Demand

Wastewater is estimated to be 80% of water demand. The Shadow Mountain Bike Park wastewater treatment requirements is estimated to be 4320 gpd (5400 x 0.8). An OWTS constructed per Jefferson County requirements will be constructed to treat the wastewater prior to discharge through an anticipated leach field.

4.4 Wastewater Discharge Permit

Wastewater Discharge will be permitted through Jefferson County and the associated OWTS design and construction process. And the State Discharge Permit process.

Section 5
WASTEWATER SYSTEM IMPROVEMENTS

5.1 General

The OWTS will be operated by the Shadow Mountain Bike Park and would be classified as a private OWTS and would be operated to meet the applicable requirements of the Colorado Department of Health and Environment (CDHE) and Jefferson County. The system may be operated by a third party contracted by Shadow Mountain Bike Park and licensed by the State of Colorado.

5.3 Wastewater Treatment

The OWTS is anticipated to be a septic system with a leach field. The OWTS design is anticipated to be for a system capacity of 4320 gpd. The Wastewater Improvements drawing in Appendix B indicates the location of an existing water well on the adjacent property. The location of the proposed septic tank and leach field is indicated to be in excess of 200 ft away from the existing well. In addition, the septic tank and leach field are located at a lower elevation than the surface elevation of the water well.

5.4 Collection

The wastewater collection system will collect waste flow at the Base Lodge and convey it through a 6-inch main to a septic tank for treatment. After proper treatment through the septic system treated wastewater will be conveyed through pipes to a leach field for discharge. All pipe and appurtenances will be designed to meet or exceed Jefferson County standards.

5.5 Estimated Costs

Estimated Costs

Item	Units	Quantity	Unit Price	Extension
Shadow Mountain Bike Park Wastewater Interceptor	LF	600	\$20	\$1200
Septic Tank	LS	1	\$10,500	\$10,500
Leach Field	LS	1	\$8,000	\$8,000
Total Estimated Cost				\$19,700

The above system improvements are all constructed as part of Shadow Mountain Bike Park. The costs included above only include capital costs for wastewater system improvements required to serve the site and are estimated from best available data. These costs do not include other costs or gains that may be incurred in the acquisition of land, financing, investing, local distribution, the salvage value of equipment or other necessary infrastructure, among others, unless specifically noted.

5.6 Rates and Charges

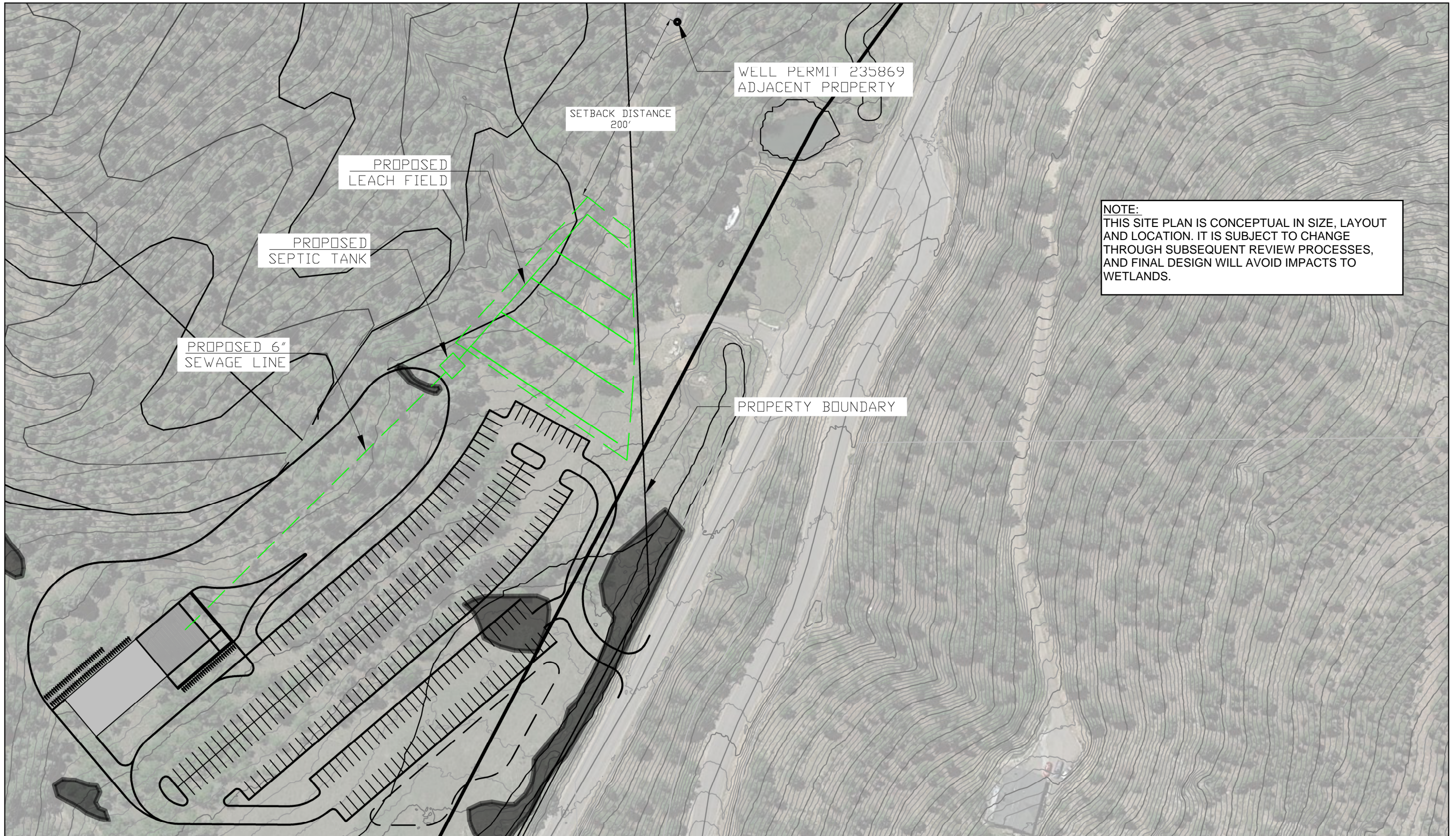
The wastewater system will be operated within the overall operation of the Shadow Mountain Bike Park through user fees charged to guests for the recreational facility.

Appendix A

100 Year Flood Plain Certification

Appendix B

Wastewater System Improvements

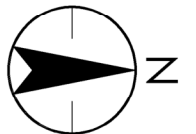


2000 S COLORADO BLVD
SUITE 300
DENVER, CO 80222

WASTEWATER SYSTEM SITE DRAWING

SHADOW MOUNTAIN BIKE PARK

SCALE: 1"=100'



Appendix C

Form 6001

FORM 6001 - ONSITE WASTEWATER REPORT

Revised: November 15, 2021

Pursuant to 22.B.1.(a) of the Wastewater Section of the Land Development Regulation, the applicant is required to complete FORM 6001 for all development proposals that rely on onsite wastewater treatment systems (OWTS).

READ ENTIRE DOCUMENT. FAILURE TO SUBMIT A COMPLETE REPORT WILL DELAY THE REVIEW PROCESS.

PURPOSE OF THE ONSITE WASTEWATER REPORT:

1. EXISTING OWTS: Evaluate the adequacy and capacity of existing OWTS to serve all proposed uses of the existing OWTS at maximum occupancy.
2. PROPOSED OWTS: Determine if there are any factors that would preclude the installation of a conforming OWTS. If there is a need for a variance, the applicant must contact the Jefferson County Public Health (JCPH) Board of Health case contacts listed below.

STANDARDS

1. Upon receipt of a Referral from Planning and Zoning (PZ), JCPH staff will:
 - a. Determine if FORM 6001 is required.
 - b. Conduct a search of JCPH OWTS Records for the project site.
 - c. Provide a summary of comments on the OWTS located on the project site.
2. PZ will provide FORM 6001 – Onsite Wastewater Report to the Applicant.
3. All designs, reports, and evaluations must be signed and stamped by a professional engineer.
4. The Applicant must submit the completed FORM 6001 to the PZ Case Manager.
5. Malfunctioning OWTS must be repaired to current Onsite Wastewater Regulations.
6. Unpermitted OWTS must be evaluated by the engineer and they must update the OWTS records (site plan drawing showing the type and size of the absorption system, the type, size, and number of compartments of the septic tank, and if possible the soil test information (such as percolation tests and / or gradation analysis)) as a condition of the development process.

FEE: There is no fee for processing this report.

PROCESSING TIME: JCPH will review the Onsite Wastewater Report and provide comments to the PZ Case Manager within the established referral timeframe. If your case requires Board of Health (BOH) approval, allow up to an additional twelve weeks for this process. Additional submittal requirements and a fee for the BOH Hearing will be required.

CONTACTS: Tracy Volkman
303.271.7529
tvolkman@jeffco.us

Jon Vickery (BOH cases only)
303 271-5763
jvickery@jeffco.us

Mary Sloan (BOH cases only)
303.271.5764
mksloan@jeffco.us

ONSITE WASTEWATER REPORT FORM 6001

PAGE 1 OF 2

PAGES 1 AND 2 MUST BE COMPLETED

Name and License Number of Professional Engineer:	Charles K. Cothorn, P.E. 24997	
Name of Designer/Evaluator:		
P&Z Case Number:	23-102980RZ	
Project Name:	Shadow Mountain Bike Park	
Property Address:	Shadow Mountain Drive, Conifer, CO 80433	
Applicant Name:	FSBR, LLC	
Applicant Phone / Email:	603-660-6604 / Phil@shadowmountainbikepark.com	
Source of Water:	Public Water System: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Individual Water Well: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Public Water System Name:		
Proposed Development Acreage:	235 acres	
Number of Platted Lots:	N/A	
Date Lots were platted:	N/A	

List each lot for this development proposal and the structures on each lot that will be served by water and the estimated volume of wastewater in gallons per day in the table below using the current Jefferson County OWTS regulations. Write "Vacant" if the lot does not have a structure on it and enter the design flow projected for the lot.

Property Identifier such as the address or lot number	Size of each lot in Acres	List of all structures served by water on each lot. For example: single-family dwelling; barn; shed; accessory dwelling unit; accessory building; commercial / retail office; restaurant; etc.	Total number of bedrooms on each lot.	Design flow (gallons per day) for each lot.
	235 acres	Guest Facility to include ticketing, restrooms, changing facilities, day use lockers, and an additional separate maintenance building.	NA	4,320 gpd

Continue to page 2 of 2

ONSITE WASTEWATER REPORT FORM 6001

PAGE 2 OF 2

Circle Yes or No to each statement and provide a supporting evaluation and or report as applicable in the following certification. Designs, evaluations, reports, and certification must be signed and stamped by a professional engineer.

Engineer's Certification

I am familiar with the current Jefferson County Onsite Wastewater Regulation. I have reviewed and evaluated the wastewater flow, in terms of strength and volume, that the proposed development will generate, and I have determined the following:

1. Is there an existing OWTS on any of the lots in the development proposal?

Yes No

If Yes, continue to numbers 2 - 4.

If No, continue to number 4.

2. The existing OWTS is/are functioning as designed and in accordance with permit conditions.

Yes No

If No, system must be repaired to current OWTS standards.

3. The existing OWTS must be modified and/or expanded to accommodate the existing and proposed uses at full development buildout and occupancy.

Yes No

If Yes, submit an evaluation with this form specifying what additional design is required to the OWTS to accommodate all existing and proposed uses at full development buildout and maximum occupancy. Design must be signed and stamped by a professional engineer.

4. The project site can conceptually accommodate a conforming OWTS that can handle the wastewater flow and strength at full build-out and maximum occupancy for the proposed development.

Yes No

If No, submit a report with this form on the factors that would prevent the installation of a conforming OWTS in accordance with Jeffco OWTS regulations. This report must be signed and stamped by a professional engineer.

I Charles K. Cothran, PE, certify that the I have reviewed this land development proposal and the above answers are true. All designs, evaluations, and reports per the above JCPH regarding existing and or proposed OWTS as applicable have been submitted with this form.

Charles K. Cothran

Print Engineer Name

Charles K. Cothran 4/15/24

Engineer Signature and Date





April 12, 2024

Jefferson County – Planning and Zoning
100 Jefferson County Parkway, Suite 3550
Golden, CO 80419
Attn: Dylan Monke, Planner

Re: Shadow Mountain Bike Park - Case No. Case No. 23-102980 RZ

Dear Mr. Monke,

We are in receipt of the Second Referral Response Letter from Colorado Parks and Wildlife, dated January 12, 2024, as part of the second referral of the application for a special use for the Shadow Mountain Bike Park project (the “**Application**”). We understand that Colorado Parks and Wildlife (“**CPW**”) cited concerns related to the impact on elk winter range, wildlife habitat connectivity, and human/wildlife conflict, which may be negatively impacted by the proposed Shadow Mountain Bike Park. CPW recommended mitigation measures that we could apply to reduce the project’s impacts on wildlife. We acknowledge these concerns and are committed to mitigating potential impacts as outlined in this letter.

Following receipt of the Second Referral Response Letter, we met with CPW to further discuss concerns relating to the Application’s impacts on wildlife and the recommended mitigation measures outlined in the letter from CPW. In the meeting, we learned more about the CPW’s comments, and some key takeaways from the meeting are summarized below:

- CPW suggested a seasonal closure of SMBP from January 1 to July 1. These dates are informed by general guidelines that CPW typically enforces at their parks and open space areas to avoid wildlife conflicts.
- CPW acknowledged that it is common for developments to take their recommendations into account but not necessarily follow all recommendations listed by them, which could well be the case for this project.
- CPW referenced Evergreen Lake as a recreational asset in the area that has high wildlife use and makes a good effort to mitigate recreational impacts on wildlife.
- It was agreed that we would prepare a response letter (this letter) to CPW’s Second Referral comment.
- Lastly, we discussed potential next steps and mitigation measures if the project were to be approved, which are outlined below in more detail.

The following 10 mitigation measures were recommended by CPW in their Second Referral Response Letter and are listed below with our response/commitment to each one.

Recommendation 1. *Implement a seasonal closure on construction activity and commercial operation from January 1 through July 1 to limit disturbance on wintering and newly born wildlife.*

Response: In the first referral process, and in response to CPW’s comments, we agreed to limit construction activity between December 1 and April 30 to avoid the elk winter season and committed

to a seasonal closure to guests between January 1 and April 1. We have considered this recommendation but have determined that a closure through July 1 would not be feasible for operation of the bike park. Therefore, we cannot agree to this recommended mitigation measure but are willing to work with CPW to track wildlife activity and consider trail closures or park closures on an as-needed basis.

Recommendation 2. *Require the use of bear resistant / bear proof trash cans and trash dumpsters for storage and disposal of waste on the property.*

Response: We are committed to using wildlife- and bear-proof trash cans and dumpsters; this measure is included in the ODP.

Recommendation 3. *Prohibit bird feeders on the property between April 1st and the Thanksgiving holiday to prevent attracting black bears.*

Response: We are committed to doing this and have included this restriction in the ODP.

Recommendation 4. *Prohibit feeding of all other wildlife on the property.*

Response: We agree to do this through education and monitoring on the property.

Recommendation 5. *Prohibit outside composting, except when completely enclosed by electrified fencing.*

Response: We have included this restriction in the ODP.

Recommendation 6. *Construction of any fencing to be completed in accordance with CPW recommended standards as outlined in the "Fencing With Wildlife in Mind" document <https://cpw.state.co.us/Documents/LandWater/PrivateLandPrograms/FencingWithWildlifeInMind.pdf>*

Response: We will adhere to these standards and have included this restriction in the ODP.

Recommendation 7. *Install round door knobs on all exterior doors instead of lever style door knobs to help prevent black bears from accessing unlocked doors.*

Response: We will adhere to these standards and have included this restriction in the ODP.

Recommendation 8. *Install motion sensing exterior lighting to illuminate the area around all exterior doors, garages, and walkways to deter wildlife conflict incidents.*

Response: We will follow lighting design standards as outlined in the ODP and will consider motion sensing lighting through further collaboration with CPW during the design and development phase, if the Project were to be approved.

Recommendation 9. *Plant native vegetation that does not require additional watering, instead of planting non-native ornamental plants and grass lawns that require irrigation and fertilization.*

Response: We commit to working with CPW on appropriate landscaping plans during project design and development, if the Project were to be approved.

Recommendation 10. *Fully enclose all crawl spaces and areas under ground level decks to prevent wildlife access.*

Response: We agree to this restriction and have included this language in the ODP.

Additionally, if the project were to be approved, we commit to working with the CPW in the following ways:

- We will connect our trail designers with CPW's trail coordinator to prepare trail designs that align with CPW's standards, guidelines, and values.
- We agree to communicate actively with CPW on the seasonal closure period and are willing to consider as-needed trail and/or park closures if wildlife issues arise during operations.

We understand CPW's concerns around wildlife in relation to the Project and are committed to mitigating the potential for impacts on wildlife and conflict between wildlife and guests to the Bike Park. We appreciate CPW's willingness to discuss their concerns with us and appreciate the opportunity to continue the discussion.

Sincerely,



Phil Bouchard
Shadow Mountain Bike Park



Jason Evans
Shadow Mountain Bike Park